

*Meeting of
June 6, 2002*

TITLE: Recommended Subject Matter Requirements for Single Subject Teaching Credentials in English, Mathematics, Science, and Social Science

Report

- Sustain high quality standards for the preparation of professional educators
- Sustain high quality standards for the performance of credential candidates

Authorized By: _____ **Date:** _____
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Executive Director

Recommended Subject Matter Requirements for Single Subject Teaching Credentials in English, Mathematics, Science, and Social Science

Professional Services Division

June 6, 2002

Executive Summary

This report presents recommended subject matter requirements (SMRs) for Single Subject Teaching Credentials in English, mathematics, science, and social science. If adopted by the Commission, the SMRs will specify the content that is to be taught in Commission-approved subject matter preparation programs and that is eligible for assessment on the Commission's subject matter examinations. The SMRs were drafted by subject matter advisory panels, reviewed by independent panels for alignment with the student academic content standards and for potential bias, evaluated by California educators statewide, and then finalized by the panels. This report also summarizes plans for the development and administration of new subject matter examinations.

Policy Issue to be Considered

What subject matter knowledge, skills, and abilities should candidates for Single Subject Teaching Credentials in English, mathematics, science, and social science have?

Fiscal Impact Statement

The development of program standards in all subject areas and SMRs in English, mathematics, science, and social science is funded from the Commission's base budget. The future development and administration of new examinations will be conducted by a National Evaluation Systems, Inc. (NES) pursuant to a contract that will have no cost to the Commission. (NES will be compensated directly from examinee fees.)

Recommendation

That the Commission adopt the attached (Appendix B) subject matter requirements for Single Subject Teaching Credential candidates in English, mathematics, science, and social science.

Recommended Subject Matter Requirements for Single Subject Teaching Credentials in English, Mathematics, Science, and Social Science

Professional Services Division

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Background

The Subject Matter Competence Requirement for a Teaching Credential

Teacher candidates in California are required to demonstrate competence in the subject matter they will be authorized to teach. Candidates have two options available for satisfying this requirement. They can either complete a Commission-approved subject matter preparation program or they can pass the appropriate Commission-adopted subject matter examination(s). Because they satisfy the same requirement, these two options should be as aligned and congruent as possible.

In the early 1990s, the Commission developed and adopted (a) standards for subject matter preparation programs and, at the same time, (b) specifications for the subject matter examinations. This work was based on the advice of subject matter advisory panels and data from validity studies, and resulted in program standards and examination specifications (defining the subject matter competence requirement) that were valid and closely aligned with each other.

The validity of the subject matter competence requirement (i.e., program standards and exam specifications) is not permanent, however. The need for periodic validity studies of the subject matter requirement is directly related to one of the Commission's most fundamental missions: to provide a strong assurance that teaching credentials are awarded to individuals who have learned the most important knowledge, skills, and abilities that are actually needed in order to succeed in California public school teaching positions. The validity of the exam specifications and program standards used by the Commission has been established in conjunction with their initial development. Professional practice and legal defensibility require, however, that the validity of these policies be periodically re-established, as job requirements and expectations may change over time.

In the late 1990s, the State Board of Education adopted K-12 student content standards in English, mathematics, science, and social science. These new standards have obvious and direct implications for the subject matter competence requirement of prospective teachers. This was recognized in SB 2042 (Alpert, 1998), which requires the Commission to ensure that subject matter program standards and examinations are aligned with the K-12 student content standards adopted by the State Board.

Subject Matter Advisory Panels

In January 2001 the Executive Director appointed subject matter panels in English, mathematics, science, and social science to advise Commission staff on the development of new subject matter program standards and examinations in these subject areas. Each panel consists of:

- classroom teachers of the subject area,
- subject area specialists in school districts, county offices of education, and postsecondary institutions,
- professors in the subject area teaching in subject matter preparation programs,
- teacher educators,
- members of relevant professional organizations,
- members of other relevant committees and advisory panels, and
- a liaison from the California Department of Education.

The panels began their work in March 2001. At the panels' initial meeting, staff provided and discussed (a) a written "charge" to the panels describing their responsibilities and (b) characteristics of the "subject matter requirements" (SMRs) that the panels were to help develop. These materials are attached as Appendix A. The SMRs are the subject-specific knowledge, skills, and abilities needed by beginning teachers. If adopted by the Commission, the SMRs will specify the content that is to be taught in Commission-approved subject matter preparation programs and that is eligible for assessment on the Commission's subject matter examinations.

In April 2001 the Executive Director signed a contract with the American Institutes for Research (AIR) to work with Commission staff and the advisory panels to develop and validate, for each of the four subject areas, SMRs for prospective secondary teachers.

Development and Validation of the SMRs

With leadership from Commission staff and assistance from AIR staff, the advisory panels in English, mathematics, science, and social science have met almost monthly since their initial meeting in March 2001. The panels have focused their work primarily on their charge to develop new program standards including SMRs.

For each of their respective subject areas, the panels developed preliminary SMRs aligned with the student content standards. The following eight sets of SMRs have been developed:

- English
- mathematics
- social science
- science, which includes
 - general science
 - biology
 - chemistry
 - Earth and planetary science (geoscience)
 - physics

Preliminary SMRs were independently reviewed by two separate groups in September 2001. An Alignment and Congruence Panel reviewed the SMRs for alignment with the state-adopted student content standards. A Bias Review Committee reviewed the SMRs for potential bias. Changes suggested by these two groups were presented to and acted on by the subject matter panels.

In January 2002, AIR launched a statewide survey-based validity study of the preliminary SMRs developed by the panels. Both paper and electronic surveys were administered, and participants included teachers, principals, curriculum specialists, and college/university faculty. Seven different surveys were developed, one each for English, mathematics, social science, biology, chemistry, Earth and planetary science, and physics. (The general science SMRs were included on each science survey.) Eligibility requirements were established and applied. The surveys asked eligible respondents to make judgments about the preliminary SMRs. For each SMR, respondents were asked to indicate (a) how important the SMR is for effective job performance by a teacher of the subject area and (b) whether it represents knowledge, skills, and abilities that teachers must possess at the beginning of their teaching career (as opposed to knowledge, skills, and abilities that could be learned on the job). In addition, respondents were asked to identify any important SMRs that were missing and to judge the comprehensiveness of the complete set of SMRs.

Approximately 6,500 California educators were selected or invited to complete a survey. Responses were received from 1,875 (29%). Of these, there were 1,377 completed surveys from eligible respondents, representing 21 percent of the selected/invited educators.

AIR analyzed and summarized the results of the validity study and presented the results to the advisory panels in March 2001. Knowledge, skills, and/or abilities in the SMRs that did not receive strong support from the validity study were reviewed according to guidelines developed by staff. Reviewed statements could be retained, revised, or deleted. Reviewed statements could be retained only under specified conditions; for example, if the panel unanimously agreed and documented a strong, clear relationship between the knowledge, skills, and/or abilities in the statement and one or more specific student academic content standards. Revisions could only include deletion of subject matter knowledge, skills, and/or abilities, or minor rewording for clarification. Revisions could also include nonsubstantive additions. No new subject matter could be added to an SMR.

Following the panels' review of the SMRs on the basis of the validity study results, the SMRs were reviewed a second time by the Commission's Bias Review Committee. Potential bias issues identified by the committee were resolved by Commission staff and, when necessary, panel members.

The validity study generated much qualitative feedback, with particular concerns regarding the science SMRs. One constituent submitted to Commission staff, with follow-up correspondence, suggested omissions and errors for review by the science advisory panel. At their March 2001 meeting, the science panel reviewed these suggestions as part of the raw validity study data, addressing each item of concern. Additionally, two memos were sent to the Commission in

April 2001, one expressing concern with the physics SMRs, the other with the science SMRs in general. These three letters clustered on the following general areas of concern:

- the level of specificity of the SMRs should match that of the student academic content standards,
- the level of difficulty of the SMRs should reflect an advanced level of understanding, and
- the organization of the SMRs should match that of the student academic content standards.

In responding to each concern, the panel again referred to the student academic content standards for guidance on whether to retain, revise, or delete statements from the SMRs. Although it was the panel's intent to develop SMRs that are broader than the student academic content standards, to emphasize alignment to these standards, references to them as well as to state-adopted curriculum frameworks were added to all four sets of SMRs at the domain level, with specific citations to particular student standards at the subdomain level (see Appendix B). Also added to each domain was language emphasizing that teacher candidates must demonstrate both broad and deep conceptual knowledge of the SMRs at an advanced, post-secondary level of rigor. Minor rewording of several SMRs was also made to clarify meaning.

Recommended Subject Matter Requirements for Single Subject Teaching Credentials in English, Mathematics, Science, and Social Science

Attached as Appendix B are final SMRs recommended by staff for adoption by the Commission. As indicated above, upon adoption the SMRs will serve two critical purposes. First, they will be included in new subject matter program standards (expected to be brought to the Commission for consideration and adoption in the fall of 2002) as curricular requirements. Second, they will serve as the content specifications for the next generation of subject matter examinations. With the exception of the SMRs in English, each set of SMRs includes two parts. The first part describes several *content domains* for subject matter understanding and skill, and the second part describes the subject matter *skills and abilities* applicable to the content domains. The English SMRs present the subject matter understanding, skills, and abilities in English as a whole. It was the unanimous decision of the English panel to not include a Part II, because the skills and abilities applicable to the domain are foundational to it.

Plans for Test Development and Administration

In December 2001, the Executive Director released a *Request for Proposals for the Development and Administration of Subject Matter Examinations for Prospective Teachers*. The purpose of this RFP was to secure a contractor to develop and administer new subject matter examinations for prospective teachers who choose to meet the subject matter competence requirement by taking and passing examinations. In March 2002, the Executive Director awarded the contract to National Evaluation Systems, Inc. (NES) on the basis of the unanimous recommendation of a Proposal Review Team consisting of Commission staff and advisory panel members. NES will develop and administer as part of the California Subject Examinations for Teachers (CSET) program (a) a new multiple subjects examination that will replace the Multiple Subjects

Assessment for Teachers (MSAT), (b) new single subject matter exams for all 13 Single Subject Teaching Credentials, and (c) a new Preliminary Educational Technology exam.¹

Content specifications for the CSET multiple subjects examination, as well as a plan for transitioning from the current exam (MSAT) to the new examination, were adopted by the Commission in September 2001. In March 2002, the Commission reviewed information about the new examinations (e.g., structure, timing) and adopted a transition plan for the new single subject exams and the Preliminary Educational Technology exam. This month staff is recommending adoption of SMRs in English, mathematics, science, and social science. Over the next two years, NES will work with Commission staff and subject matter advisory panels to develop and validate SMRs for the remaining tests in the CSET program for Commission adoption. NES will develop all of the subject matter exams on the basis of Commission-adopted SMRs. The CSET contract will run through October 2006, and will include test administrations through June 2006.

The CSET in English, mathematics, science, social science, and multiple subjects are expected to be ready for initial test administration in January 2003. CSET in physical education, art, music, languages other than English, and Preliminary Educational Technology are expected to be ready for initial administration approximately half way through the 2003-04 testing year.² The remaining exams (agriculture, business, health science, home economics, industrial and technology education) are expected to be ready for initial administration approximately half way through the 2004-05 testing year.

NES will conduct standard setting studies for the CSET either just before or after each initial test administration. Results of these studies will be presented to the Commission with staff-recommended passing standards.

The NES test development and administration contract will be a “no cost” contract for the Commission. That is, the contractor will be compensated completely and directly by examinees through test fees. As part of the test fees, NES will collect funds from examinees and remit them to the Commission to be used toward the Commission’s costs of operating its testing programs (e.g., salaries, operating expenses).

The CSET program will include several enhancements in test services for candidates. Some of these services are as follows:

- internet registration;
- internet score reporting;
- electronic registration bulletin;
- electronic test guides that include sample items for each content domain on a subtest (a complete sample test for the multiple subjects examination);
- regular, late, *and* emergency registration periods;

¹ There are two purposes for including the new Preliminary Educational Technology exam in the new contract. First, given the frequency of technological change, this test should be updated more frequently than most other examinations. Second, because the Preliminary Educational Technology exam is a low-volume exam, combining it in a contract with several high-volume exams (e.g., elementary subject matter exam, exams in social science and English) will keep examinee fees reasonable.

² A testing year is from July 1 through June 30.

- no additional fee to change the test date, test area, or to make changes to a registration file (i.e., name, address, social security number);
- payment of fees by credit card;
- diagnostic feedback on the score reports of candidates who do not pass a test or subtest; and
- out-of-state test administrations in states from which high volumes of educators apply for California certification: Arizona, Illinois, Massachusetts, Michigan, New York, Oregon, Pennsylvania, Texas, Utah, and Washington.

NES is also in the process of implementing enhancements in services for the Commission and other constituents of the testing program. Some of these services are as follows:

- internet and/or mail score reports to institutions and teacher preparation programs, including examinee performance data for each test administration and annual passing rate information;
- a faculty manual to support teacher preparation programs in their advisement of students;
- a website, accessible by the Commission only, to facilitate communication between Commission staff and NES, and that will include registration information (e.g., registration counts per administration, rosters and totals for test sites, and examinee information) and scoring information (e.g., statewide pass rate information and examinee scores and scoring history).

Appendix A

**Written “Charge” to the Subject Matter Advisory Panels,
Including Characteristics of the Subject Matter Requirements (SMRs)**

COMMISSION ON TEACHER CREDENTIALING

1900 Capitol Avenue
Sacramento, California 95814-4213



Charge to the Subject Matter Advisory Panels in English, Mathematics, Science, and Social Science

March 2001

The Executive Director of the California Commission on Teacher Credentialing has appointed the Subject Matter Advisory Panels in English, Mathematics, Science, and Social Science to work with and advise the Commission's staff and contractor to accomplish the following the task:

Develop new *Standards of Quality and Effectiveness for Subject Matter Programs* in each of four subject areas. An important element of the new standards will be a delineation of the subject-specific knowledge, skills, and abilities that beginning teachers need to know and be able to do. These will be referred to as *subject matter requirements*.

The new standards will guide sponsors of subject matter programs for prospective teachers. The subject matter requirements will delineate the subject-specific knowledge, skills, and abilities (a) to be taught in programs and (b) eligible for assessment on exams candidates can take in lieu of completing programs.

The program standards and subject matter requirements shall take into account the context for California K-12 public education, best practices in subject-matter pedagogy, and the knowledge base and methods of the disciplines under consideration.

The work and products of each panel shall be:

- Focused on the subject matter preparation of candidates for California Single Subject Teaching Credentials.
- Informed by the knowledge and expertise of its members, previously adopted program standards, the new Elementary Subject Matter Program Standards, and all applicable California laws and regulations.
- Aligned with the State-adopted K-12 student academic content standards and curriculum frameworks.
- Compatible with the assumptions, format, and organization of other segments of the Senate Bill 2042 reforms.

Upon their completion, the new *Standards of Quality and Effectiveness for Subject Matter Programs* will be presented to the Commission for adoption.

The New Subject Matter Requirements

The new subject matter requirements in English, mathematics, science, and social science must have the following characteristics:

1. They must be aligned with the state's student content and performance standards for grades 6-12. Competence in the new subject matter requirements should enable beginning teachers to effectively assist students to meet the student content and performance standards. Although the new subject matter requirements must be aligned with the student standards, they can be broader than those standards.
2. Their intended purposes and uses are to delineate the subject matter knowledge, skills, and abilities that are (a) to be provided to candidates in a subject matter preparation program, and (b) eligible for inclusion on the exams (i.e., exam content specifications).
3. In terms of their use as exam content specifications, the subject matter requirements should enable (a) examination development specialists to create test items (both selected-response and constructed-response items) that have high validity, (b) Commission staff to monitor the work of examination development specialists in relation to clear, valid content specifications, and (c) candidates for credentials to ascertain clearly the breadth and content of subject matter knowledge, skills, and abilities eligible for assessment on the exams.
4. The new subject matter requirements for each subject area are expected to have two parts. The first part would describe several *content domains* for subject matter understanding and skill, and the second part would describe the subject matter *skills and abilities* applicable to the content domains. (See the draft subject matter requirements for prospective elementary teachers online at: <http://www.ctc.ca.gov/profserv/progstan.html>.)
5. In science, the Commission offers Single Subject Teaching Credentials in four emphasis areas: biology, chemistry, geoscience, and physics. Prospective science teachers are expected to have in-depth competence in one area (their emphasis area), and broad competence across all four areas (referred to as general science). Thus, the Science Panel will develop subject matter requirements for each emphasis area as well as a set of general science subject matter requirements, which is expected to include competencies from the four emphasis areas.

Appendix B

Recommended Subject Matter Requirements for Single Subject Teaching Credentials

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English Subject Matter Requirements

Part I: Content Domains for Subject Matter Understanding and Skill in English

More than ever before, teachers of English in California's middle and high schools must deliver a complex and dynamic curriculum to students of every socioeconomic, linguistic and cultural background. Furthermore, society is increasingly technologically and media oriented. The Reading/Language Arts Framework for California Public Schools: Kindergarten Through Grade Twelve (1999) forms the basis for the preparation of English teachers, who must equip their students to meet the challenges of this changing world. In this context, new paradigms and models are required for teaching English/Language Arts. Multiple forms of literacy demand a broad theoretical knowledge of language and literacy acquisition, while new information technologies require an emphasis on critical analysis of both print and non-print texts.

Candidates for Single Subject Teaching Credentials in English have a broad knowledge of literature, language and linguistics, rhetoric and composition, and communication studies. Candidates must be able to read and write well for a variety of purposes and communicate effectively within a variety of rhetorical contexts. In addition, candidates must have experience in theater arts, public speaking, journalism, textual analysis of nonfiction and electronic media, and production of technologically enhanced documents. This broad scope of background and skills ensures a greater degree of success in English/Language Arts classrooms for California's public school children.

Domain 1. Literature and Textual Analysis

Candidates demonstrate knowledge of the foundations and contexts of the literature and textual analysis contained in the English-Language Arts Content Standards for California Public Schools (1997) as outlined in the Reading/Language Arts Framework for California Public Schools: Kindergarten Through Grade Twelve (1999) at a post secondary level of rigor. Candidates have both broad and deep conceptual knowledge of the subject matter. The candidate's preparation should include breadth of knowledge in literature, literary analysis and criticism, as well as non-literary text analysis. Literary analysis presumes in-depth exploration of the relationship between form and content. The curriculum should embrace representative selections from different literary traditions and major works from diverse cultures. Advanced study of multicultural writers is also fundamental preparation for teaching these works. Shakespeare remains integral to the secondary school curriculum; advanced study of his work is, therefore, essential to future secondary teachers. Candidates must be enthusiastic readers and writers, who know and apply effective reading strategies and compose thoughtful, well-crafted responses to literary and non-literary texts. Candidates will be able to:

1.1 Literary Analysis

- a. Recognize, compare, and evaluate different literary traditions to include:
 - ◆ American (inclusive of cultural pluralism)
 - ◆ British (inclusive of cultural pluralism)
 - ◆ World literature and literature in translation (inclusive of cross-cultural literature)
 - ◆ Mythology and oral tradition

- b. Trace development of major literary movements in historical periods (e.g., Homeric Greece, medieval, neoclassic, romantic, modern)
- c. Describe the salient features of adolescent/Young Adult literature
- d. Analyze and interpret major works by representative writers in historical, aesthetic, political, and philosophical contexts

(English-Language Arts Content Standards for California Public Schools, Grade 6, Reading: 2.4; Grades 11-12, Reading: 2.2, 3.5-7)

1.2 Literary Elements

- a. Distinguish salient features of genres (e.g., short stories, non-fiction, drama, poetry, novel)
- b. Define and analyze basic elements of literature (e.g., plot, setting, character, point of view, theme, narrative structure, figurative language, tone, diction, style)
- c. Articulate the relationship between the expressed purposes and the characteristics of different forms of dramatic literature (e.g., comedy, tragedy, drama, dramatic monologue)
- d. Develop critical thinking and analytic skill through close reading of texts

(English-Language Arts Content Standards for California Public Schools, Grade 6, Reading: 1.1-2, 2.1, 2.4, 2.6, 2.8, 3.0; Grade 7, Reading: 1.1, 2.4, 3.1-5; Grade 8, Reading: 1.1, 2.7, 3.0; Grades 9-10, Reading: 1.1, 2.8, 3.1-4, 3.7-10; Grades 11-12, Reading: 2.2, 3.1-4)

1.3 Literary Criticism

- a. Research and apply criticism of major texts and authors using print and/or electronic resources
- b. Research and apply various approaches to interpreting literature (e.g., aesthetic, historical, political, philosophical)

(English-Language Arts Content Standards for California Public Schools, Grade 6, Reading: 2.1-2, 2.6-8, 3.6; Grade 7, Reading: 2.1, 2.4, 2.6, 3.0; Grade 8, Reading: 2.2, 2.6, 3.0; Grades 9-10, Reading: 2.2, 2.4, 2.8, 3.5-7, 3.11-12, Writing 1.6-7; Grades 11-12, Reading: 2.2, 2.4, 3.8-9, Writing 1.6-7)

1.4 Analysis of Non-Literary Texts

- a. Compare various features of print and visual media (e.g., film, television, internet)
- b. Evaluate structure and content of a variety of consumer, workplace, and public documents
- c. Interpret individual works in their cultural, social, and political contexts

(English-Language Arts Content Standards for California Public Schools, Grade 6, Reading: 2.0, 3.0; Grade 7, Reading: 2.1-5, 2.2, 3.0; Grade 8, Reading: 2.1-7, 3.0; Grades 9-10, Reading: 2.1, 2.2, 2.4-7, 3.0; Grades 11-12, Reading: 2.1-3, 2.6, 3.0)

Domain 2. Language, Linguistics, and Literacy

Candidates demonstrate knowledge of the foundations and contexts of the language, linguistics, and literacy contained in the English-Language Arts Content Standards for California Public Schools (1997) as outlined in the Reading/Language Arts Framework for California Public Schools: Kindergarten Through Grade Twelve (1999) at a post secondary level of rigor. Candidates have both broad and deep conceptual knowledge of the subject matter. Many California students, coming from a variety of linguistic and sociocultural backgrounds, face specific challenges in mastering the English language. The diversity of this population requires the candidate to understand the principles of language acquisition and development. Candidates must become knowledgeable about the nature of human language, language variation, and historical and cultural perspectives on the development of English. In addition, candidates must acquire a complex understanding of the development of English literacy among both native and non-native speakers. Candidates will be able to:

2.1 Human Language Structures

- a. Recognize the nature of human language, differences among languages, the universality of linguistic structures, and change across time, locale, and communities
- b. Demonstrate knowledge of word analysis, including sound patterns (phonology) and inflection, derivation, compounding, roots and affixes (morphology)
- c. Demonstrate knowledge of sentence structures (syntax), word and sentence meanings (semantics), and language function in communicative context (pragmatics)
- d. Use appropriate print and electronic sources to research etymologies; recognize conventions of English orthography and changes in word meaning and pronunciation

(English-Language Arts Content Standards for California Public Schools, Grade 6, Reading: 1.1-5; Grades 7-8, Reading: 1.2; Grades 9-10, Reading: 1.1-3)

2.2 Acquisition and Development of Language and Literacy

- a. Explain the influences of cognitive, affective, and sociocultural factors on language acquisition and development
- b. Explain the influence of a first language on second language development
- c. Describe methods and techniques for developing academic literacy (e.g., tapping prior knowledge through semantic mapping, word analogies, cohesion analysis)

(English-Language Arts Content Standards for California Public Schools, Grades 6-12, Reading: 1.0)

2.3 Literacy Studies

- a. Recognize the written and oral conventions of Standard English, and analyze the social implications of mastering them
- b. Describe and explain cognitive elements of reading and writing processes (e.g., decoding and encoding, construction of meaning, recognizing and using text conventions of different genres)
- c. Explain metacognitive strategies for making sense of text (e.g., pre-reading activities, predicting, questioning, word analysis, concept formation)

(English-Language Arts Content Standards for California Public Schools, Grades 6-12, Reading: 1.0)

2.4 Grammatical Structures of English

- a. Identify methods of sentence construction (e.g., sentence combining with coordinators and subordinators; sentence embedding and expanding with clausal and phrasal modifiers)
- b. Analyze parts of speech and their distinctive structures and functions (e.g., noun phrases including count and noncount nouns and the determiner system; prepositions, adjectives, and adverbs; word transformations)
- c. Describe the forms and functions of the English verb system (e.g., modals, verb complements, verbal phrases)

(English-Language Arts Content Standards for California Public Schools, Grade 8, Reading: 1.2)

Domain 3. Composition and Rhetoric

Candidates demonstrate knowledge of the foundations and contexts of the composition and rhetoric contained in the English-Language Arts Content Standards for California Public Schools (1997) as outlined in the Reading/Language Arts Framework for California Public Schools: Kindergarten Through Grade Twelve (1999) at a post secondary level of rigor. Candidates have both broad and deep conceptual knowledge of the subject matter. Candidates face dynamic challenges in the domains of oral and written communication. They must make appropriate use of current text-production technologies and develop sensitivity to patterns of communication used by different social and cultural groups. Candidates are competent writers and speakers who are able to communicate appropriately in various rhetorical contexts, using effective text structures, word choice, sentence options, standard usage conventions, and advanced research methods as needed. The subject matter preparation program provides opportunities for candidates to develop skills and confidence in public speaking. Candidates will be able to:

3.1 Written Composing Processes (Individual and Collaborative)

- a. Reflect on and describe their own writing processes
- b. Investigate and apply alternative methods of prewriting, drafting, responding, revising, editing, and evaluating
- c. Employ such strategies as graphic organizers, outlines, notes, charts, summaries, or précis to clarify and record meaning
- d. Integrate a variety of software applications (e.g., databases, graphics, spreadsheets) to produce print documents and multi-media presentations

(English-Language Arts Content Standards for California Public Schools, Grade 6, Reading: 2.1-2, 2.4, Writing: 1.4-6; Grade 7, Reading: 2.3-4, Writing: 1.3-4, 1.6-7; Grade 8, Reading: 2.4, Writing: 1.1, 1.4-1.6, Listening and Speaking: 1.4; Grades 9-10, Reading: 2.4, Writing: 1.8-9; Grades 11-12, Writing: 1.4, 1.7-9, Listening and Speaking: 2.4)

3.2 Rhetorical Features of Literary and Non-Literary, Oral and Written Texts

- a. Recognize and use a variety of writing applications (e.g., short story, biographical, autobiographical, expository, persuasive, business and technical documents, historical investigation)
- b. Demonstrate awareness of audience, purpose, and context

- c. Recognize and use various text structures (e.g., narrative and non-narrative organizational patterns)
- d. Apply a variety of methods to develop ideas within an essay (e.g., analogy, cause and effect, compare and contrast, definition, illustration, description, hypothesis)
- e. Apply critical thinking strategies to evaluate methods of persuasion, including but not limited to:
 - ♦ Types of appeal (e.g., appeal to reason, emotion, morality)
 - ♦ Types of persuasive speech (e.g., propositions of fact, value, problem, policy)
 - ♦ Logical fallacies (e.g., bandwagon, red herring, glittering generalities, ad hominem)
 - ♦ Advertising techniques (e.g., Maslow's hierarchy of needs)
 - ♦ Logical argument (e.g., inductive/deductive reasoning, syllogisms, analogies)
 - ♦ Classical argument (e.g., claim, qualifiers, rules of evidence, warrant)

(English-Language Arts Content Standards for California Public Schools, Grade 6, Reading: 2.1-2, 2.4, 2.6, 2.8, Writing: 1.1-3, 1.6, 2.1-5, Listening and Speaking: 1.8-9; Grade 7, Reading: 1.3, 2.2-3, Writing: 1.1-3, 1.7, 2.1-5, Listening and Speaking: 1.1, 1.3; Grade 8, Reading: 1.3, 2.2, Writing: 1.1-3, 1.52.1-6, Listening and Speaking: 1.8; Grades 9-10, Writing: 1.1-2, 1.4, 1.9, 2.1-6, Listening and Speaking: 1.5, 1.10, 1.13; Grades 11-12, Reading: 1.3, 2.2, 2.4-6, Writing: 1.1-5, 1.9, 2.1-6, Listening and Speaking: 1.4, 1.12-13)

3.3 Rhetorical Effects of Grammatical Elements

- a. Employ precise and extensive vocabulary and effective diction to control voice, style, and tone
- b. Use clause joining techniques (e.g., coordinators, subordinators, punctuation) to express logical connections between ideas
- c. Identify and use clausal and phrasal modifiers to control flow, pace, and emphasis (e.g., adjective clauses, appositives, participles and verbal phrases, absolutes)
- d. Identify and use devices to control focus in sentence and paragraph (e.g., active and passive voice, expletives, concrete subjects, transitional phrases)
- e. Maintain coherence through use of cohesive devices

(English-Language Arts Content Standards for California Public Schools, Grade 6, Reading: 1.1, Writing: 1.2, 1.6, Written and Oral English Language Conventions: 1.1-5; Grade 7, Writing: 1.1, 1.7, Written and Oral English Language Conventions: 1.1-7; Grade 8, Writing: 1.2, 1.6, Written and Oral English Language Conventions: 1.1-6, Listening and Speaking: 1.5-6; Grades 9-10, Writing: 1.1-2, 1.6, 1.9, Written and Oral English Language Conventions: 1.1-5; Grades 11-12, Reading: 2.1-2, Writing: 1.2-5, 1.9, Written and Oral English Language Conventions: 1.1-3, Listening and Speaking: 1.5)

3.4 Conventions of Oral and Written Language

- a. Apply knowledge of linguistic structure to identify and use the conventions of Standard Edited English
- b. Recognize, understand, and use a range of conventions in both spoken and written English, including:
 - ♦ Conventions of effective sentence structure (e.g., clear pronoun reference, parallel structure, appropriate verb tense)

- ◆ Preferred usage (e.g., verb/subject agreement, pronoun agreement, idioms)
- ◆ Conventions of pronunciation and intonation
- ◆ Conventional forms of spelling
- ◆ Capitalization and punctuation

(English-Language Arts Content Standards for California Public Schools, Grade 6, Reading: 1.1, Written and Oral English Language Conventions: 1.1-5; Grade 7, Written and Oral English Language Conventions: 1.1-7; Grade 8, Writing: 1.2, Written and Oral English Language Conventions: 1.1-6, Listening and Speaking: 1.6; Grades 9-10, Writing: 1.9, Written and Oral English Language Conventions: 1.9; Grades 11-12, Writing: 1.4, Written and Oral English Language Conventions: 1.1-3, Listening and Speaking: 1.8)

3.5 Research Strategies

- a. Develop and apply research questions
- b. Demonstrate methods of inquiry and investigation
- c. Identify and use multiple resources (e.g., oral, print, electronic; primary and secondary), and critically evaluate the quality of the sources
- d. Interpret and apply findings
- e. Use professional conventions and ethical standards of citation and attribution
- f. Demonstrate effective presentation methods, including multi-media formats

(English-Language Arts Content Standards for California Public Schools, Grade 6, Reading: 1.1, 2.1, 2.3, 2.6-8, Writing: 1.4-5, Listening and Speaking: 1.1-2, 1.6-7, 2.1, 2.3; Grade 7, Reading: 2.2, 2.6, Writing: 1.4-5, Listening and Speaking: 1.2, 1.6-7, 2.1, 2.3; Grade 8, Reading: 2.2, 2.7, Writing: 1.3-6, Listening and Speaking: 1.2-3, 1.6-8, 2.3; Grades 9-10, Reading: 2.2-5, 2.8, Writing: 1.3-8, Listening and Speaking: 1.7, 2.2; Grades 11-12, Writing: 1.4, 1.6-8, Listening and Speaking: 2.4)

Domain 4. Communications: Speech, Media, and Creative Performance

Candidates demonstrate knowledge of the foundations and contexts of the speech, media, and creative performance contained in the English-Language Arts Content Standards for California Public Schools (1997) as outlined in the Reading/Language Arts Framework for California Public Schools: Kindergarten Through Grade Twelve (1999) at a post secondary level of rigor. Candidates have both broad and deep conceptual knowledge of the subject matter. The Reading/Language Arts Framework for California Public Schools (1999) puts consistent emphasis on analysis and evaluation of oral and media communication as well as on effective public speaking and performance. The candidate must possess the breadth of knowledge needed to integrate journalism, technological media, speech, dramatic performance, and creative writing into the language arts curriculum, including sensitivity to cultural approaches to communication. The subject matter preparation program should include opportunities for candidates to obtain knowledge and experience in these areas. The candidate skillfully applies the artistic and aesthetic tools and sensitivities required for creative expression. Candidates will be able to:

4.1 Oral Communication Processes

- a. Identify features of, and deliver oral performance in, a variety of forms (e.g., impromptu, extemporaneous, persuasive, expository, interpretive, debate)

- b. Demonstrate and evaluate individual performance skills (e.g., diction, enunciation, vocal rate, range, pitch, volume, body language, eye contact, response to audience)
- c. Articulate principles of speaker/audience interrelationship (e.g., interpersonal communication, group dynamics, public address)
- d. Identify and demonstrate collaborative communication skills in a variety of roles (e.g., listening supportively, facilitating, synthesizing, stimulating higher level critical thinking through inquiry)

(English-Language Arts Content Standards for California Public Schools, Grade 6, Reading: 1.1, Listening and Speaking: 1.1-8, 2.0; Grade 7, Listening and Speaking: 1.1-7, 2.0; Grade 8, Listening and Speaking: 1.1-8, 2.0; Grades 9-10, Listening and Speaking: 1.1, 1.3-6, 1.8-13, 2.0; Grades 11-12, Reading: 2.6, Listening and Speaking: 1.4-6, 1.8-13, 2.0)

4.2 Media Analysis and Journalistic Applications

- a. Analyze the impact on society of a variety of media forms (e.g., television, advertising, radio, internet, film)
- b. Recognize and evaluate strategies used by the media to inform, persuade, entertain, and transmit culture
- c. Identify aesthetic effects of a media presentation
- d. Demonstrate effective and creative application of these strategies and techniques to prepare presentations using a variety of media forms and visual aids

(English-Language Arts Content Standards for California Public Schools, Grade 6, Reading: 2.1-2, 2.6, Listening and Speaking: 1.9; Grade 7, Reading: 2.1, Listening and Speaking: 1.8-9; Grade 8, Reading: 2.1, 2.3, Listening and Speaking: 1.8-9; Grades 9-10, Reading: 2.1, Listening and Speaking: 1.1-2, 1.7, 1.9, 1.14; Grades 11-12, Reading: 2.1, Writing: 2.6, Listening and Speaking: 1.1-4, 1.9, 1.14, 2.4; Visual and Performing Arts Content Standards for California Public Schools, Theatre, Grades 6-12, 5.0: Connections, Relationships, Applications)

4.3 Dramatic Performance

- a. Describe and use a range of rehearsal strategies to effectively mount a production (e.g., teambuilding, scheduling, organizing resources, setting priorities, memorization techniques, improvisation, physical and vocal exercises)
- b. Employ basic elements of character analysis and approaches to acting, including physical and vocal techniques, that reveal character and relationships
- c. Demonstrate basic knowledge of the language of visual composition and principles of theatrical design (e.g., set, costume, lighting, sound, props)
- d. Apply fundamentals of stage directing, including conceptualization, blocking (movement patterns), tempo, and dramatic arc (rising and falling action)
- e. Demonstrate facility in a variety of oral performance traditions (e.g., storytelling, epic poetry, recitation)

(English-Language Arts Content Standards for California Public Schools, Grade 6, Listening and Speaking: 2.1, 2.3; Grade 7, Listening and Speaking: 2.1; Grade 8, Listening and Speaking: 1.1, 2.1-2, 2.5; Grades 9-10, Listening and Speaking: 2.1, 2.4; Grades 11-12, Listening and Speaking: 1.7, 1.9-10, 2.5; Visual and Performing Arts

Content Standards for California Public Schools, Theatre, Grades 6-12, 1.0: Artistic Perception, 2.0: Creative Expression, 3.0 Historical and Cultural Context, 4.0 Aesthetic Valuing)

4.4 Creative Writing

- a. Demonstrate facility in creative composition in a variety of genres (e.g., poetry, stories, plays, film)
- b. Understand and apply processes and techniques that enhance the impact of the creative writing product (e.g., workshopping; readings; recasting of genre, voice, perspective)
- c. Demonstrate skill in composing creative and aesthetically compelling responses to literature

(English-Language Arts Content Standards for California Public Schools, Grade 6-12, Writing: 2.1)

Mathematics Subject Matter Requirements

Part I: Content Domains for Subject Matter Understanding and Skill in Mathematics

Domain 1. Algebra

Candidates demonstrate an understanding of the foundations of the algebra contained in the Mathematics Content Standards for California Public Schools (1997) as outlined in the Mathematics Framework for California Public Schools: Kindergarten Through Grade Twelve (1999) from an advanced standpoint. To ensure a rigorous view of algebra and its underlying structures, candidates have a deep conceptual knowledge. They are skilled at symbolic reasoning and use algebraic skills and concepts to model a variety of problem-solving situations. They understand the power of mathematical abstraction and symbolism.

1.1 Algebraic Structures

- a. Know why the real and complex numbers are each a field, and that particular rings are not fields (e.g., integers, polynomial rings, matrix rings)
- b. Apply basic properties of real and complex numbers in constructing mathematical arguments (e.g., if $a < b$ and $c < 0$, then $ac > bc$)
- c. Know that the rational numbers and real numbers can be ordered and that the complex numbers cannot be ordered, but that any polynomial equation with real coefficients can be solved in the complex field

(Mathematics Content Standards for California Public Schools, Grade 6, Number Sense: 1.0, 2.0; Grade 7, Algebra and Functions: 1.0; Algebra I: 1.0, 3.0-7.0, 9.0-15.0, 24.0, 25.0; Geometry: 1.0, 17.0; Algebra II: 1.0-8.0, 11.0, 24.0, 25.0; Trigonometry: 17.0; Mathematical Analysis: 2.0; Linear Algebra: 9.0, 11.0)

1.2 Polynomial Equations and Inequalities

- a. Know why graphs of linear inequalities are half planes and be able to apply this fact (e.g., linear programming)
- b. Prove and use the following:
 - ♦ The Rational Root Theorem for polynomials with integer coefficients
 - ♦ The Factor Theorem
 - ♦ The Conjugate Roots Theorem for polynomial equations with real coefficients
 - ♦ The Quadratic Formula for real and complex quadratic polynomials
 - ♦ The Binomial Theorem
- c. Analyze and solve polynomial equations with real coefficients using the Fundamental Theorem of Algebra

(Mathematics Content Standards for California Public Schools, Grade 7, Algebra and Functions: 2.0-4.0; Algebra I: 1.0, 2.0, 4.0-10.0, 12.0-15.0, 17.0-23.0; Algebra II: 2.0-11.0, 16.0, 17.0; Trigonometry: 17.0, 18.0; Mathematical Analysis: 4.0, 6.0)

1.3 Functions

- a. Analyze and prove general properties of functions (i.e., domain and range, one-to-one, onto, inverses, composition, and differences between relations and functions)

- b. Analyze properties of polynomial, rational, radical, and absolute value functions in a variety of ways (e.g., graphing, solving problems)
- c. Analyze properties of exponential and logarithmic functions in a variety of ways (e.g., graphing, solving problems)

(Mathematics Content Standards for California Public Schools, Grade 6, Algebra and Functions: 1.0; Grade 7, Number Sense: 1.0, 2.0; Algebra and Functions: 3.0; Algebra I: 3.0-6.0, 10.0, 13.0, 15.0-18.0, 21.0-23.0; Algebra II: 1.0-4.0, 6.0-17.0, 24.0, 25.0; Trigonometry: 2.0, 4.0-8.0, 19.0; Mathematical Analysis: 6.0, 7.0; Calculus: 9.0)

1.4 Linear Algebra

- a. Understand and apply the geometric interpretation and basic operations of vectors in two and three dimensions, including their scalar multiples and scalar (dot) and cross products
- b. Prove the basic properties of vectors (e.g., perpendicular vectors have zero dot product)
- c. Understand and apply the basic properties and operations of matrices and determinants (e.g., to determine the solvability of linear systems of equations)

(Mathematics Content Standards for California Public Schools, Algebra I: 9.0; Algebra II: 2.0; Mathematical Analysis: 1.0; Linear Algebra: 1.0-12.0)

Domain 2. Geometry

Candidates demonstrate an understanding of the foundations of the geometry contained in the Mathematics Content Standards for California Public Schools (1997) as outlined in the Mathematics Framework for California Public Schools: Kindergarten Through Grade Twelve (1999) from an advanced standpoint. To ensure a rigorous view of geometry and its underlying structures, candidates have a deep conceptual knowledge. They demonstrate an understanding of axiomatic systems and different forms of logical arguments. Candidates understand, apply, and prove theorems relating to a variety of topics in two- and three-dimensional geometry, including coordinate, synthetic, non-Euclidean, and transformational geometry.

2.1 Parallelism

- a. Know the Parallel Postulate and its implications, and justify its equivalents (e.g., the Alternate Interior Angle Theorem, the angle sum of every triangle is 180 degrees)
- b. Know that variants of the Parallel Postulate produce non-Euclidean geometries (e.g., spherical, hyperbolic)

(Mathematics Content Standards for California Public Schools, Algebra I: 8.0, 24.0; Geometry: 1.0-3.0, 7.0, 13.0)

2.2 Plane Euclidean Geometry

- a. Prove theorems and solve problems involving similarity and congruence
- b. Understand, apply, and justify properties of triangles (e.g., the Exterior Angle Theorem, concurrence theorems, trigonometric ratios, Triangle Inequality, Law of Sines, Law of Cosines, the Pythagorean Theorem and its converse)

- c. Understand, apply, and justify properties of polygons and circles from an advanced standpoint (e.g., derive the area formulas for regular polygons and circles from the area of a triangle)
- d. Justify and perform the classical constructions (e.g., angle bisector, perpendicular bisector, replicating shapes, regular n-gons for n equal to 3, 4, 5, 6, and 8)
- e. Use techniques in coordinate geometry to prove geometric theorems

(Mathematics Content Standards for California Public Schools, Grade 6, Algebra and Functions: 2.0, 3.0; Measurement and Geometry: 2.0; Grade 7, Measurement and Geometry: 1.0-3.0; Algebra I: 8.0, 24.0; Geometry: 1.0-6.0, 8.0-16.0, 18.0-21.0; Algebra II: 16.0, 17.0; Trigonometry: 12.0-14.0, 18.0, 19.0; Mathematical Analysis: 5.0)

2.3 Three-Dimensional Geometry

- a. Demonstrate an understanding of parallelism and perpendicularity of lines and planes in three dimensions
- b. Understand, apply, and justify properties of three-dimensional objects from an advanced standpoint (e.g., derive the volume and surface area formulas for prisms, pyramids, cones, cylinders, and spheres)

(Mathematics Content Standards for California Public Schools, Grade 6, Measurement and Geometry: 1.0; Grade 7, Measurement and Geometry: 2.0; Algebra I: 24.0; Geometry: 2.0, 3.0, 12.0, 17.0; Mathematical Analysis: 5.0)

2.4 Transformational Geometry

- a. Demonstrate an understanding of the basic properties of isometries in two- and three-dimensional space (e.g., rotation, translation, reflection)
- b. Understand and prove the basic properties of dilations (e.g., similarity transformations or change of scale)

(Mathematics Content Standards for California Public Schools, Geometry: 11.0, 22.0)

Domain 3. Number Theory

Candidates demonstrate an understanding of the number theory and a command of the number sense contained in the Mathematics Content Standards for California Public Schools (1997) as outlined in the Mathematics Framework for California Public Schools: Kindergarten Through Grade Twelve (1999) from an advanced standpoint. To ensure a rigorous view of number theory and its underlying structures, candidates have a deep conceptual knowledge. They prove and use properties of natural numbers. They formulate conjectures about the natural numbers using inductive reasoning, and verify conjectures with proofs.

3.1 Natural Numbers

- a. Prove and use basic properties of natural numbers (e.g., properties of divisibility)
- b. Use the Principle of Mathematical Induction to prove results in number theory
- c. Know and apply the Euclidean Algorithm
- d. Apply the Fundamental Theorem of Arithmetic (e.g., find the greatest common factor and the least common multiple, show that every fraction is equivalent to a unique fraction)

where the numerator and denominator are relatively prime, prove that the square root of any number, not a perfect square number, is irrational)

(Mathematics Content Standards for California Public Schools, Grade 6, Number Sense: 2.0; Grade 7, Number Sense: 1.0; Algebra I: 1.0, 2.0, 12.0, 24.0, 25.0; Geometry: 1.0; Algebra II: 21.0, 23.0, 25.0; Mathematical Analysis: 3.0)

Domain 4. Probability and Statistics

Candidates demonstrate an understanding of the statistics and probability distributions for advanced placement statistics contained in the Mathematics Content Standards for California Public Schools (1997) as outlined in the Mathematics Framework for California Public Schools: Kindergarten Through Grade Twelve (1999) from an advanced standpoint. To ensure a rigorous view of probability and statistics and their underlying structures, candidates have a deep conceptual knowledge. They solve problems and make inferences using statistics and probability distributions.

4.1 Probability

- a. Prove and apply basic principles of permutations and combinations
- b. Illustrate finite probability using a variety of examples and models (e.g., the fundamental counting principles)
- c. Use and explain the concept of conditional probability
- d. Interpret the probability of an outcome
- e. Use normal, binomial, and exponential distributions to solve and interpret probability problems

(Mathematics Content Standards for California Public Schools, Grade 6, Statistics, Data Analysis, and Probability: 3.0; Algebra II: 18.0-20.0; Probability and Statistics: 1.0-4.0; Advanced Probability and Statistics: 1.0-4.0, 7.0, 9.0, 17.0, 18.0)

4.2 Statistics

- a. Compute and interpret the mean, median, and mode of both discrete and continuous distributions
- b. Compute and interpret quartiles, range, variance, and standard deviation of both discrete and continuous distributions
- c. Select and evaluate sampling methods appropriate to a task (e.g., random, systematic, cluster, convenience sampling) and display the results
- d. Know the method of least squares and apply it to linear regression and correlation
- e. Know and apply the chi-square test

(Mathematics Content Standards for California Public Schools, Grade 6, Statistics, Data Analysis, and Probability: 1.0, 2.0; Grade 7, Statistics, Data Analysis, and Probability: 1.0; Probability and Statistics: 5.0-7.0; Advanced Probability and Statistics: 4.0-6.0, 8.0, 10.0-13.0, 15.0-17.0, 19.0)

Domain 5. Calculus

Candidates demonstrate an understanding of the trigonometry and calculus contained in the Mathematics Content Standards for California Public Schools (1997) as outlined in the Mathematics

Framework for California Public Schools: Kindergarten Through Grade Twelve (1999) from an advanced standpoint. To ensure a rigorous view of trigonometry and calculus and their underlying structures, candidates have a deep conceptual knowledge. They apply the concepts of trigonometry and calculus to solving problems in real-world situations.

5.1 Trigonometry

- Prove that the Pythagorean Theorem is equivalent to the trigonometric identity $\sin^2 x + \cos^2 x = 1$ and that this identity leads to $1 + \tan^2 x = \sec^2 x$ and $1 + \cot^2 x = \csc^2 x$
- Prove the sine, cosine, and tangent sum formulas for all real values, and derive special applications of the sum formulas (e.g., double angle, half angle)
- Analyze properties of trigonometric functions in a variety of ways (e.g., graphing and solving problems)
- Know and apply the definitions and properties of inverse trigonometric functions (i.e., arcsin, arccos, and arctan)
- Understand and apply polar representations of complex numbers (e.g., DeMoivre's Theorem)

(Mathematics Content Standards for California Public Schools, Algebra I: 24.0; Geometry: 3.0, 14.0, 18.0, 19.0; Algebra II: 24.0, 25.0; Trigonometry: 1.0-6.0, 8.0-11.0, 19.0; Mathematical Analysis: 1.0, 2.0; Calculus: 18.0, 20.0)

5.2 Limits and Continuity

- Derive basic properties of limits and continuity, including the Sum, Difference, Product, Constant Multiple, and Quotient Rules, using the formal definition of a limit
- Show that a polynomial function is continuous at a point
- Know and apply the Intermediate Value Theorem, using the geometric implications of continuity

(Mathematics Content Standards for California Public Schools, Algebra I: 24.0; Geometry: 3.0; Algebra II: 1.0, 15.0; Mathematical Analysis: 8.0; Calculus: 1.0-4.0)

5.3 Derivatives and Applications

- Derive the rules of differentiation for polynomial, trigonometric, and logarithmic functions using the formal definition of derivative
- Interpret the concept of derivative geometrically, numerically, and analytically (i.e., slope of the tangent, limit of difference quotients, extrema, Newton's method, and instantaneous rate of change)
- Interpret both continuous and differentiable functions geometrically and analytically and apply Rolle's Theorem, the Mean Value Theorem, and L'Hopital's rule
- Use the derivative to solve rectilinear motion, related rate, and optimization problems
- Use the derivative to analyze functions and planar curves (e.g., maxima, minima, inflection points, concavity)
- Solve separable first-order differential equations and apply them to growth and decay problems

(Mathematics Content Standards for California Public Schools, Algebra I: 5.0-8.0, 10.0, 11.0, 13.0, 21.0, 23.0; Geometry: 3.0; Algebra II: 1.0, 9.0, 10.0, 12.0, 15.0; Trigonometry: 7.0, 15.0-19.0; Mathematical Analysis: 5.0, 7.0; Calculus: 1.0, 4.0-12.0, 27.0)

5.4 Integrals and Applications

- a. Derive definite integrals of standard algebraic functions using the formal definition of integral
- b. Interpret the concept of a definite integral geometrically, numerically, and analytically (e.g., limit of Riemann sums)
- c. Prove the Fundamental Theorem of Calculus, and use it to interpret definite integrals as antiderivatives
- d. Apply the concept of integrals to compute the length of curves and the areas and volumes of geometric figures

(Mathematics Content Standards for California Public Schools, Algebra I: 24.0; Geometry: 9.0; Calculus: 13.0-23.0)

5.5 Sequences and Series

- a. Derive and apply the formulas for the sums of finite arithmetic series and finite and infinite geometric series (e.g., express repeating decimals as a rational number)
- b. Determine convergence of a given sequence or series using standard techniques (e.g., Ratio, Comparison, Integral Tests)
- c. Calculate Taylor series and Taylor polynomials of basic functions

(Mathematics Content Standards for California Public Schools, Algebra I: 24.0, 25.0; Algebra II: 21.0-23.0; Mathematical Analysis: 8.0; Calculus: 23.0-26.0)

Domain 6. History of Mathematics

Candidates understand the chronological and topical development of mathematics and the contributions of historical figures of various times and cultures. Candidates know important mathematical discoveries and their impact on human society and thought. These discoveries form a historical context for the content contained in the Mathematics Content Standards for California Public Schools (1997) as outlined in the Mathematics Framework for California Public Schools: Kindergarten Through Grade Twelve (1999; e.g., numeration systems, algebra, geometry, calculus).

6.1 Chronological and Topical Development of Mathematics

- a. Demonstrate understanding of the development of mathematics, its cultural connections, and its contributions to society
- b. Demonstrate understanding of the historical development of mathematics, including the contributions of diverse populations as determined by race, ethnicity, culture, geography, and gender

Part II: Subject Matter Skills and Abilities

Applicable to the Content Domains in Mathematics

Candidates for Single Subject Teaching Credentials in mathematics use inductive and deductive reasoning to develop, analyze, draw conclusions, and validate conjectures and arguments. As they reason, they use counterexamples, construct proofs using contradictions, and create multiple representations of the same concept. They know the interconnections among mathematical ideas, and use techniques and concepts from different domains and sub-domains to model the same problem. They explain mathematical interconnections with other disciplines. They are able to communicate their mathematical thinking clearly and coherently to others, orally, graphically, and in writing, through the use of precise language and symbols.

Candidates solve routine and complex problems by drawing from a variety of strategies while demonstrating an attitude of persistence and reflection in their approaches. They analyze problems through pattern recognition and the use of analogies. They formulate and prove conjectures, and test conclusions for reasonableness and accuracy. They use counterexamples to disprove conjectures.

Candidates select and use different representational systems (e.g., coordinates, graphs). They understand the usefulness of transformations and symmetry to help analyze and simplify problems. They make mathematical models to analyze mathematical structures in real contexts. They use spatial reasoning to model and solve problems that cross disciplines.

(Mathematics Content Standards for California Public Schools, Grade 6, Mathematical Reasoning: 1.0-3.0; Grade 7, Mathematical Reasoning: 1.0-3.0)

General Science Subject Matter Requirements

Part I: Content Domains for Subject Matter Understanding and Skill in General Science

Domain 1. Astronomy

Candidates demonstrate an understanding of the foundations of the astronomy contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of astronomy and its underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates understand that knowledge of the structure and composition of the universe can be learned from studying stars and galaxies and their evolution. They recognize that objects in the sky move in regular and predictable patterns. Candidates explain how and why the moon's appearance changes during the four-week lunar cycle. They understand how telescopes magnify the appearance of distant objects in the sky, including the moon and the planets. They realize that the solar system consists of planets and other bodies that orbit the sun in predictable paths.

1.1 Astronomy

- a. Describe the chemical composition and physical structure of the universe
- b. Describe the structure of the solar system and its place in the Milky Way galaxy
- c. Distinguish between stars and planets
- d. Recognize that stars vary in color, size, and luminosity
- e. Describe a simple model of how fusion in stars produces heavier elements and results in the production of energy, including light
- f. Describe the regular and predictable patterns of stars and planets in time and location
- g. Explain and predict changes in the moon's appearance (phases)
- h. Describe the use of astronomical instruments in collecting data, and use astronomical units and light years to describe distances

(Science Content Standards for California Public Schools, Grades 3:4a-e; Grade 5: 5a-c; Grade 6: 7a; Grade 7: 6d, 7a; Grade 8:4a-e; Grades 9-12, Earth Sciences: 1a, 1e, 1g, 2a, 2c, 2e-f)

Domain 2. Dynamic Processes of the Earth (Geodynamics)

Candidates demonstrate an understanding of the foundations of the geodynamics contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of geodynamics and its underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates understand that Earth's features can be explained by a variety of dynamic processes that have occurred in the past and continue to occur. They understand that plate tectonics account for most of the important features of Earth's surface and major geologic events. Candidates explain how surficial processes and agents such as waves, wind, water, and ice are slowly modifying Earth's land surface. They understand how weathering, transport, and deposition of sediment are related to this reshaping. Candidates are familiar with evidence from rocks that allows us to understand geologic history and the evolution of life on Earth. They can use observed

properties of rocks and minerals to determine their processes of formation. Candidates understand that most of the energy on the Earth comes from the sun. They know that energy from the sun heats Earth unevenly, causing air movements that result in changing weather patterns. They use their understanding of heat to explain the many phenomena on Earth's surface that are affected by the transfer of energy through radiation and convection.

2.1 Tectonic Processes and Features

- a. Diagram the features that provide evidence for plate tectonics
- b. Summarize the thermal processes driving plate movement
- c. Explain how density and buoyancy are related to plate tectonics
- d. Describe types of plate boundaries
- e. Relate the causes of volcanoes, earthquakes, and earth resources to tectonic processes
- f. Summarize earthquake processes in terms of epicenter, focal mechanism, distance, and materials, and the role various factors play in the amount of damage caused by an earthquake

(Science Content Standards for California Public Schools, Grade 6: 1a-g; Grade 8: 4a-e; Grades 9-12, Earth Sciences: 1e, 1g, 2c, 3b, 3d)

2.2 Rock Formation

- a. Diagram and explain the rock cycle
- b. Describe relative and absolute dating techniques, including how half-lives are used in radiometric dating
- c. Compare uniformitarianism and catastrophism

(Science Content Standards for California Public Schools, Grade 4: 4a ; Grade 7: 3c, 4a-e; Grades 9-12, Chemistry: 11f)

2.3 Shaping Earth's Surface: Surficial Processes and Features

- a. Describe the dynamic processes of erosion, deposition, and transport
- b. Describe coastal processes including beach erosion and natural hazards
- c. Describe the effects of natural hazards, including earthquakes, volcanic eruptions, landslides, and floods, on natural and human-made habitats and environmental and human responses to those events

(Science Content Standards for California Public Schools, Grade 4: 5c; Grade 6: 1e, 1f, 2a-d)

2.4 Energy in the Earth System

- a. Diagram the water cycle and describe interrelationships of surface and sub-surface reservoirs
- b. Explain daily and seasonal changes in the sky (i.e., the sun's position and the intensity and duration of sunlight)
- c. Analyze the uneven heating of Earth by the sun
- d. Discuss the effects of air movements on weather
- e. Describe the energy transfer processes of convection, conduction, and radiation in relation to the atmosphere/ocean and Earth's interior structure

- f. Interpret weather maps to predict weather patterns

(Science Content Standards for California Public Schools, Grade 3: 4e; Grade 5: 3a-d, 4a-e; Grade 6: 4a-e; Grades 9-12, Earth Sciences: 5a-b)

Domain 3. Earth Resources

Candidates demonstrate an understanding of the Earth resources contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of Earth resources and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates know there are many different natural energy and material resources, including air, soil, rocks, minerals, petroleum, fresh water, wildlife, and forests, and know how to classify them as renewable or nonrenewable. They realize that sources of energy and materials differ in amounts, distribution, usefulness, and the time required for their formation. Candidates understand that the utility of energy sources is determined by factors that are involved in converting these sources to useful forms and the consequences of the conversion process. They know the natural origin of the materials used to make common objects.

3.1 Earth Resources

- a. Describe a variety of energy resources, including fossil fuels, nuclear fuels, solar, and biomass
- b. Recognize earth materials as resources (e.g., rocks, minerals, soils, and water)
- c. Identify resources as renewable vs. nonrenewable
- d. Compare extraction and recycling in relation to energy, cost, and demand
- e. Explain sustainable uses of resources with respect to utility, cost, human population, and environmental consequences

(Science Content Standards for California Public Schools, Grade 2: 3e; Grade 6: 6a-c; Grades 9-12, Earth Sciences: 9a, 9c)

Domain 4. Ecology

Candidates demonstrate an understanding of the foundations of the ecology contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of ecology and its underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates understand how organisms in ecosystems exchange energy and nutrients among themselves and with the environment. They can identify factors that affect organisms within an ecosystem, including natural hazards and human activity.

4.1 Ecology

- a. Explain energy flow and nutrient cycling through ecosystems (e.g., food chain, food web)
- b. Explain matter transfer (e.g., biogeochemical cycles) in ecosystems
- c. Distinguish between abiotic and biotic factors in an ecosystem
- d. Compare the roles of photosynthesis and respiration in an ecosystem
- e. Describe interrelationships within and among ecosystems (e.g., predator/prey)
- f. Identify and explain factors that affect population types and size (e.g., competition for resources, niche, habitats, species and population interactions, abiotic factors)

(Science Content Standards for California Public Schools, Grade 4: 2a-c, 3a-c; Grade 5: 2f-g; Grade 6: 5a-e)

Domain 5. Genetics and Evolution

Candidates demonstrate an understanding of the foundations of the genetics and evolution contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of genetics and evolution and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates understand that a typical cell of any organism contains genetic instructions that specify its traits. They can explain how biological evolution accounts for the diversity of species that developed through gradual processes over many generations. Candidates can describe evidence used to explain the evolution of life on Earth.

5.1 Genetics and Evolution

- a. Explain the inheritance of traits which are determined by one or more genes, including dominance, recessiveness, sex linkage, phenotypes, genotypes, and incomplete dominance
- b. Solve problems that illustrate monohybrid and dihybrid crosses
- c. Compare sexual and asexual reproduction
- d. Explain how the coding of DNA (deoxyribonucleic acid) controls the expression of traits by genes
- e. Define mutations and explain their causes
- f. Explain the process of DNA replication
- g. Describe evidence, past and present, that supports the theory of evolution, including diagramming relationships that demonstrate shared characteristics of fossil and living organisms
- h. Explain the theory of natural selection, including adaptation, speciation, and extinction
- i. List major events that affected the evolution of life on Earth (e.g., climate changes, asteroid impacts)

(Science Content Standards for California Public Schools, Grade 7: 2a-e, 3a-e; Grades 9-12, Biology/Life Sciences: 4c, 7c, 8a)

Domain 6. Molecular Biology and Biochemistry

Candidates demonstrate an understanding of the foundations of the molecular biology and biochemistry contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve

(2002) from an advanced standpoint. To ensure a rigorous view of molecular biology and biochemistry and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates understand and apply the principles of chemistry that underlie the functioning of biological systems. They describe the properties of biochemical compounds that make them essential to life.

6.1 Molecular Biology and Biochemistry

- a. Demonstrate understanding that a small subset of elements (C, H, O, N, P, S) makes up most of the chemical compounds in living organisms by combining in many ways
- b. Recognize and differentiate the structure and function of molecules in living organisms, including carbohydrates, lipids, proteins, and nucleic acids
- c. Describe the process of protein synthesis, including transcription and translation
- d. Compare anaerobic and aerobic respiration
- e. Describe the process of photosynthesis

(Science Content Standards for California Public Schools, Grade 5: 2f-g; Grade 6: 5a; Grade 8: 6b-c; Grades 9-12, Biology/Life Sciences: 1d, 1f, 1g, 1h, 4a, Chemistry: 10c)

Domain 7. Cell and Organismal Biology

Candidates demonstrate an understanding of the foundations of the cell and organismal biology contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of cell and organismal biology and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates understand that all living organisms are composed of cells and explain important cellular processes. They describe and give examples of how the anatomy and physiology of plants and animals illustrate the complementary nature of structure and function. Candidates demonstrate understanding of physical principles that underlie biological structures and functions. They apply these principles to important biological systems.

7.1 Cell and Organismal Biology

- a. Describe organelles and explain their function in the cell
- b. Relate the structure of organelles and cells to their functions
- c. Identify and contrast animal and plant cells
- d. Explain the conversion, flow, and storage of energy of the cell
- e. Identify the function and explain the importance of mitosis and meiosis as processes of cellular and organismal reproduction
- f. Compare single-celled and multicellular organisms, noting the role of cell differentiation in the development of multicellular organisms
- g. Describe the levels of organization (e.g., cells, tissues, organs, systems, organisms) in plants and animals
- h. Describe the structures and functions of human body systems, including, but not limited to, the skeletal, reproductive, nervous, and circulatory systems
- i. Explain the major structures and their functions in vascular and nonvascular plants
- j. Describe the life processes of various plant groups, including, but not limited to, reproduction, photosynthesis, respiration, and transpiration

- k. Explain the reproductive processes in flowering plants

(Science Content Standards for California Public Schools, Grade 3: 1b, 1c; Grade 5: 2a, 2e; Grade 7: 1a-f, 5a-g, 6d, 6h-j)

Domain 8. Waves

Candidates demonstrate an understanding of the foundations of waves as contained in the Science Content Standards for California Public Schools (1998) and outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of waves and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates understand that all waves have a common set of characteristic properties. They apply their knowledge of these properties to describe and predict the behavior of waves, including light waves, sound waves, and seismic waves. Candidates apply the simple principles of optics to explain how various lenses work.

8.1 Waves

- Compare the characteristics of sound, light, and seismic waves (e.g., transverse/longitudinal, travel through various media, relative speed)
- Explain that energy is transferred by waves without mass transfer and provide examples
- Explain how lenses are used in simple optical systems, including the camera, telescope, microscope, and the eye
- Explain and apply the laws of reflection and refraction
- Compare transmission, reflection, and absorption of light in matter

(Science Content Standards for California Public Schools, Grade 3: 1d, 2a-d, 4c; Grade 6: 3a; Grade 7: 6a, 6c-g; Grades 9-12, Physics: 4a-b, 4d, 4f)

Domain 9. Forces and Motion

Candidates demonstrate an understanding of the foundations of forces and motion as contained in the Science Content Standards for California Public Schools (1998) and outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of forces and motion and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates describe the motion of an object and understand the relationships among its velocity, speed, distance, time, and acceleration. They understand the relationship among force, mass, and acceleration. Candidates use Newton's laws to predict the motion of objects.

9.1 Forces and Motion

- Discuss and apply Newton's laws (i.e., first, second, third, and law of universal gravitation)
- Define pressure and relate it to fluid flow and buoyancy (e.g., heart valves, atmospheric pressure)

- c. Describe the relationships among position, distance, displacement, speed, velocity, acceleration, and time, and perform simple calculations using these variables for both linear and circular motion
- d. Identify the separate forces that act on a body (e.g., gravity, pressure, tension/compression, normal force, friction) and describe the net force on the body
- e. Construct and analyze simple vector and graphical representations of motion and forces (e.g., distance, speed, time)
- f. Identify fundamental forces, including gravity, nuclear forces, and electromagnetic forces (magnetic and electric), and explain their roles in nature, such as the role of gravity in maintaining the structure of the universe
- g. Explain and calculate mechanical advantages for levers, pulleys, and inclined planes

(Science Content Standards for California Public Schools, Grade 7: 6h-j; Grade 8: 1a-f, 2a-g)

Domain 10. Electricity and Magnetism

Candidates demonstrate an understanding of the foundations of the electricity and magnetism contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of electricity and magnetism and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates understand that electric and magnetic phenomena are related. They use knowledge of electricity and magnetism to explain many practical applications.

10.1 Electricity and Magnetism

- a. Describe and provide examples of electrostatic and magnetostatic phenomena
- b. Predict charges or poles based on attraction/repulsion observations
- c. Build a simple compass and use it to determine direction of magnetic fields, including the Earth's magnetic field
- d. Relate electric currents to magnetic fields and describe the application of these relationships, such as in electromagnets, electric current generators, motors, and transformers
- e. Design and interpret simple series and parallel circuits
- f. Define and calculate power, voltage differences, current, and resistance in simple circuits

(Science Content Standards for California Public Schools, Grade 4: 1a-g; Grade 9-12, Physics: 5a-c)

Domain 11. Heat Transfer and Thermodynamics

Candidates demonstrate an understanding of the foundations of heat transfer and thermodynamics as contained in the Science Content Standards for California Public Schools (1998) and outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of heat transfer and thermodynamics and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates explain how heat flows in a predictable manner. They understand that energy cannot be created or destroyed, although in many processes energy is transferred to the environment as heat. Candidates

apply their knowledge to explain how many phenomena on Earth's surface are affected by the transfer of energy through radiation and convection currents.

11.1 Heat Transfer and Thermodynamics

- a. Know the principle of conservation of energy and apply it to energy transfers
- b. Discuss how the transfer of energy as heat is related to changes in temperature
- c. Diagram the direction of heat flow in a system
- d. Describe the methods of heat transfer by conduction, convection, and radiation, and provide examples for each
- e. Explain how chemical energy in fuel is transformed to heat
- f. Design and explain experiments to induce a physical change such as freezing, melting, or boiling
- g. Distinguish between physical and chemical changes and provide examples of each

(Science Content Standards for California Public Schools, Grade 6: 3a-d, 4d; Grade 8: 3b, 3d-e, 5c-d; Grade 9-12, Physics: 3a-c, Chemistry: 7a-c)

Domain 12. Structure and Properties of Matter

Candidates demonstrate an understanding of the structure and properties of matter contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of matter and its underlying structures, candidates have a deep conceptual knowledge of the content area. Candidates know that more than 100 elements of matter exist, each with distinct properties and a distinct atomic structure. They describe both macroscopic and microscopic properties of matter including intermolecular and intramolecular forces. They know that the organization of the periodic table is based on the properties of the elements and reflects the structure of atoms. Candidates understand how the periodic table is constructed and the periodic trends in chemical and physical properties that can be seen in the table. They recognize chemical reactions as processes that involve the rearrangement of electrons to break and form bonds with different atomic partners. Candidates demonstrate understanding of the principles of chemistry that underlie the functioning of biological systems.

12.1 Structure and Properties of Matter

- a. Identify, describe, and diagram the basic components within an atom (i.e., proton, neutron, and electron)
- b. Know that isotopes of any element have different numbers of neutrons but the same number of protons, and that some isotopes are radioactive
- c. Differentiate between atoms, molecules, elements, and compounds
- d. Compare and contrast states of matter and describe the role energy plays in the conversion from one state to another
- e. Discuss the physical properties of matter including structure, melting point, boiling point, hardness, density, and conductivity
- f. Recognize that all chemical substances are characterized by a unique set of physical properties
- g. Define and calculate density, and predict whether an object will sink or float in a fluid

- h. Explain that chemical changes in materials result in the formation of a new substance corresponding to the rearrangement of the atoms in molecules
- i. Explain and apply principles of conservation of matter to chemical reactions, including balancing chemical equations
- j. Distinguish among acidic, basic, and neutral solutions by their observable properties
- k. Describe the construction and organization of the periodic table
- l. Based on position in the periodic table, predict which elements have characteristics of metals, semi-metals, non-metals, and inert gases
- m. Explain chemical reactivity using position on the periodic table
- n. Predict and explain chemical bonding using elements' positions in the periodic table
- o. Recognize that inorganic and organic compounds (e.g., water, salt, carbohydrates, lipids, proteins, nucleic acids) are essential to processes within living systems
- p. Explain the central role of carbon in living system chemistry

(Science Content Standards for California Public Schools, Grade 8: 3a-c, 5a-e, 6a, 6c, 7a-c, 8a-d; Grades 9-12, Chemistry: 7b, 11c)

Biology/Life Science Subject Matter Requirements

Part I: Content Domains for Subject Matter Understanding and Skill in Biology/Life Science

Domain 1. Cell Biology and Physiology

Candidates demonstrate an understanding of the foundations of the cell biology and physiology contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of cell biology and physiology and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates demonstrate an understanding of the fundamental life processes of plants and animals that depend on a variety of chemical reactions that occur in specialized areas of an organism's cells. They recognize the coordination of organ systems and the relationship of structure to function. They use this understanding to apply the concepts of homeostasis and its mechanisms to the regulation of human body systems.

1.1 Prokaryotic and Eukaryotic Cells

- a. Compare prokaryotic cells, eukaryotic cells, and viruses in terms of complexity, general structure, differentiation, and their requirements for growth and replication

(Science Content Standards for California Public Schools, Grades 9-12, Biology/Life Sciences: 1c, 1d)

1.2 Cellular Reproduction

- a. Describe the stages of the cell cycle
- b. Diagram and describe the stages of the mitotic process

(Science Content Standards for California Public Schools, Grades 7: 1e)

1.3 Plant and Animal Cell Anatomy and Physiology

- a. Diagram the structure of the cell membrane and relate the structure to its function
- b. Explain methods of transport across the membrane (e.g., diffusion, active transport, endocytosis and exocytosis)
- c. Explain the role of semipermeable membranes in cellular communication
- d. Explain the role of the endoplasmic reticulum and Golgi apparatus in the secretion of proteins
- e. Explain the role of chloroplasts in obtaining and storing usable energy
- f. Explain the role of mitochondria in cellular respiration
- g. Explain the role of enzymes in chemical reactions and describe an experiment to test the catalytic role of enzymes and factors that affect enzyme activity (e.g., levels of protein organization, temperature, ionic conditions, concentration of enzyme and substrate, pH)
- h. Explain anabolic and catabolic pathways involved in the metabolism of macromolecules (e.g., polysaccharides, nucleic acids, proteins, lipids)

(Science Content Standards for California Public Schools, Grades 9-12, Biology/Life Sciences: 1a-b, 1d-j)

1.4 Integration and Control of Human Organ Systems

- a. Relate the complementary activity of major body systems (e.g., circulatory, digestive, respiratory, excretory) to provide cells with oxygen and nutrients and remove waste products
- b. Explain and analyze the role of the nervous system in mediating communication between different parts of the body and the body's interactions with the environment
- c. Explain the homeostatic role of the major organs (e.g., kidneys, heart, brain)
- d. Explain the function of feedback loops in the nervous and endocrine systems to regulate conditions in the body and predict the effects of disturbances on these systems
- e. Explain the role of hormones (e.g., digestive, reproductive, osmoregulatory) in providing internal feedback mechanisms for homeostasis at the cellular level and in whole organisms
- f. Describe the role of the musculo-skeletal system in providing structure, support, and locomotion to the human organism

(Science Content Standards for California Public Schools, Grade 7: 5a-b; Grades 9-12, Biology/Life Sciences: 9a-i)

1.5 Physiology of the Immune System

- a. Explain the humoral response to infection
- b. Compare cell mediated and humoral responses to infection
- c. Explain how vaccination works and distinguish among variables affecting success rate
- d. Predict the consequences of a compromised immune system [e.g., AIDS (Acquired Immune Deficiency Syndrome)]

(Science Content Standards for California Public Schools, Grades 9-12, Biology/Life Sciences: 10b-f)

Domain 2. Genetics

Candidates demonstrate an understanding of the foundations of the genetics contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of genetics and its underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates demonstrate understanding of the structure and function of genetic material. They understand the genetic coding of DNA (deoxyribonucleic acid) and how this coding specifies the sequence of amino acids in proteins characteristic of the organism. Candidates know that a multicellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization. They understand the roles of mutation and sexual reproduction in genetic variation within populations. They know how new biotechnology methods incorporate exogenous DNA into cells to alter their genetic composition, and the resulting ethical implications of using such methods. Candidates also understand the relationship of genetics to evolution and how the frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time.

2.1 Chromosome Structure and Function

- a. Relate the structure and function of DNA, RNA (ribonucleic acid), and proteins to the concept of variation in organisms

- b. Describe chromosome structure as a sequence of genes each with a specific locus

(Science Content Standards for California Public Schools, Grades 9-12, Biology/Life Sciences: 1d, 3d, 4a-c, 4e, 5a-b)

2.2 Patterns of Inheritance

- a. Explain the necessity of both meiosis and fertilization in promoting variation
- b. Describe the role of chromosomes in determining phenotypes (e.g., sex determination, chromosomal aberrations)
- c. Predict the probable outcome of phenotypes in a genetic cross from the genotypes of the parents and mode of inheritance (e.g., autosomal or X-linked, dominant or recessive, co-dominance)
- d. Explain the genetic and cellular bases for Mendel's laws of dominance, segregation and independent assortment

(Science Content Standards for California Public Schools, Grades 9-12, Biology/Life Sciences: 2a-g, 3b-c, 8a)

2.3 Gene Expression

- a. Explain how random chromosome segregation explains the probability that a particular allele will be in a gamete
- b. Recognize that specialization of cells in multicellular organisms is usually due to different patterns of gene expression rather than to differences among the genes themselves
- c. Describe how alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus maintained in a gene pool
- d. Distinguish when and why mutations in the DNA sequence of a gene may or may not affect the expression of the gene or the sequence of amino acids in an encoded protein

(Science Content Standards for California Public Schools, Grades 9-12, Biology/Life Sciences: 3a, 4c-d, 7b-c)

2.4 Biotechnology

- a. Recognize how genetic engineering (biotechnology) produces biomedical and agricultural products
- b. Describe the construction of recombinant DNA molecules by basic DNA technology including restriction digestion by endonucleases, gel electrophoresis, ligation, and transformation

(Science Content Standards for California Public Schools, Grades 9-12, Biology/Life Sciences: 5c-e)

2.5 Bioethics

- a. Discuss issues of bioethics including genetic engineering, cloning, the human genome project, gene therapy, and medical implications

(Science Content Standards for California Public Schools, Grades 9-12, Investigation and Experimentation: 1m)

Domain 3. Evolution

Candidates demonstrate an understanding of the foundations of the evolution contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of evolution and its underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates explain that evolution is the result of genetic changes that occur in constantly changing environments. They know that the frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time. Based on available evidence, they relate evolutionary theory to the history of life on Earth.

3.1 Natural Selection

- a. Explain why natural selection acts on the phenotype rather than the genotype of an organism
- b. Predict the survival potential of various groups of organisms based on the amount of diversity in their gene pools

(Science Content Standards for California Public Schools, Grades 9-12, Biology/Life Sciences: 7a-d)

3.2 Evolutionary Patterns

- a. Analyze fossil evidence with regard to biological diversity, episodic speciation, and mass extinction
- b. Analyze the effects of evolutionary patterns on the diversity of organisms (e.g., genetic drift, convergent evolution, punctuated equilibrium, patterns of selection)
- c. Explain the conditions for Hardy-Weinberg equilibrium and why they are unlikely to appear in nature, and solve equations to predict the frequency of genotypes in a population

(Science Content Standards for California Public Schools, Grades 9-12, Biology/Life Sciences: 7e-f, 8b-c, 8e)

3.3 Mechanisms for Speciation

- a. Distinguish between the accommodation of an individual organism to its environment and the gradual adaptation of a lineage of organisms through genetic change
- b. Describe a scenario that demonstrates the effects of reproductive or geographic isolation on speciation

(Science Content Standards for California Public Schools, Grades 9-12, Biology/Life Sciences: 6g, 8d)

3.4 History and Origin of Life

- a. Explain the theoretical origins of life on Earth
- b. Construct a branching diagram (cladogram) from a variety of data sources illustrating the phylogeny between organisms of currently identified taxonomic groups

(Science Content Standards for California Public Schools, Grades 9-12, Biology/Life Sciences: 8f-g)

Domain 4. Ecology

Candidates demonstrate an understanding of the foundations of the evolution contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of evolution and its underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates demonstrate understanding that stability in an ecosystem is a balance among competing effects. They understand the interrelationships within ecosystems, the flow of matter and energy through ecosystems, and how humans impact the environment.

4.1 Biodiversity

- a. Define biodiversity and describe the effects on biodiversity of alteration of habitat

(Science Content Standards for California Public Schools, Grades 9-12, Biology/Life Sciences: 6a-b)

4.2 Energy Flow and Nutrient Cycles

- a. Evaluate the importance of stability of producers, consumers, and decomposers

(Science Content Standards for California Public Schools, Grades 9-12, Biology/Life Sciences: 6e-f)

4.3 Interrelationships and Change in Ecosystems

- a. Describe various species interactions (e.g., predator/prey, parasitism, mutualism, commensalism, competition)
- b. Analyze the fluctuations in population size in an ecosystem due to the relative rates of birth, immigration, emigration, and death
- c. Analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, and changes in population size

(Science Content Standards for California Public Schools, Grades 9-12, Biology/Life Sciences: 6b-c)

Chemistry Subject Matter Requirements

Part I: Content Domains for Subject Matter Understanding and Skill in Chemistry

Domain 1. Atomic and Molecular Structure

Candidates demonstrate an understanding of atomic and molecular structure as contained in the Science Content Standards for California Public Schools (1998) and outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of atomic and molecular structure, candidates have a deep conceptual knowledge of the subject matter. Candidates demonstrate understanding of how periodicity of physical and chemical properties of the elements relates to atomic structure. They base this on a demonstrated understanding of current models of atomic, molecular, and subatomic structure.

1.1 Periodic Table and Periodicity

- Differentiate periodic groups and families of elements and their properties
- Relate valence electrons and the electron shell structure (s, p, d, f orbitals) to an element's position in the periodic table
- Predict periodic trends including electronegativity, ionization energy, and the relative sizes of ions and atoms

(Science Content Standards for California Public Schools, Grades 9-12, Chemistry: 1c-d, 1f-g)

1.2 Atomic Structure

- Analyze the evolution of the atomic model (including, but not limited to, the historical importance of the Bohr model and the development of the quantum structure of the atom)
- Relate atomic spectroscopy and the photoelectric effect to the quantum structure of the atom
- Illustrate the position and describe the properties of quarks, protons, neutrons, and electrons within atoms

(Science Content Standards for California Public Schools, Grades 9-12, Chemistry: h-j, 11g)

1.3 Molecular Structure and Chemical Bonds

- Compare types of molecular bonds including ionic, covalent and hydrogen bonds
- Draw Lewis dot structures for compounds and ions
- Predict molecular geometries using Lewis dot structures and hybridized atomic orbitals, e.g., valence shell electron pair repulsion model (VSEPR)
- Relate intermolecular electrostatic forces, including Van der Waals, polar and induced polar, and ionic, to their expected states of matter and their characteristic physical properties

(Science Content Standards for California Public Schools, Grades 9-12, Chemistry: 2a-h)

Domain 2. Chemical Reactions

Candidates demonstrate an understanding of the foundations of chemical reactions as contained in the Science Content Standards for California Public Schools (1998) and outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of chemical reactions and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates demonstrate an understanding of the principles that underlie the conditions governing chemical reactions. They apply the principle of conservation of matter and are able to quantify the mass of products and reactants. Candidates understand that chemical reaction rates depend on factors that affect the frequency of collisions and reactivities of reactant molecules. They explain and predict the behavior of chemical systems by applying the principle of chemical equilibrium as a dynamic process at the molecular level.

2.1 Conservation of Matter and Stoichiometry

- Calculate molar mass, mass, number of particles, and volume, at standard temperature and pressure (STP) for elements and compounds
- Calculate the masses of reactants and products, and percent yield using balanced chemical equations, including problems with a limiting reagent
- Distinguish reaction types, including single replacement, double replacement, synthesis, decomposition, and combustion
- Utilize the rules of oxidation states to balance oxidation-reduction reactions

(Science Content Standards for California Public Schools, Grades 9-12, Chemistry: 3a-g)

2.2 Reaction Rates and Chemical Equilibrium

- Predict the effect of temperature, pressure, and concentration on chemical equilibrium (LeChatelier's principle) and the reaction rate
- Interpret a diagram showing activation energy along the reaction pathway
- Identify and predict the role of catalysts on the reaction rate
- Write and calculate an equilibrium constant expression for a given reaction
- Know that equilibrium is established when the reaction rates of the forward and reverse reactions are equal

(Science Content Standards for California Public Schools, Grades 9-12, Chemistry: 8a-d, 9a-c)

Domain 3. Kinetic Molecular Theory

Candidates demonstrate an understanding of the foundations of the kinetic molecular theory contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of kinetic molecular theory and its underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates understand kinetic molecular theory and use it to generate a description of the motion of atoms and molecules. They use kinetic molecular theory to explain and predict the properties and behaviors of gases.

3.1 Gases and Their Properties

- Solve problems using the ideal gas law and use the ideal gas law to predict pressure-volume, pressure-temperature, and volume-temperature relationships

- b. Relate pressure, volume, and temperature to the kinetic theory of atoms and molecules in gases
- c. Know and use STP to solve gas law problems
- d. Convert between Kelvin and Celsius temperature scales
- e. Recognize the significance of absolute zero
- f. Solve problems using Dalton's law of partial pressures and Graham's Laws of diffusion

(Science Content Standards for California Public Schools, Grades 9-12, Chemistry: 4a-i)

Domain 4. Solution Chemistry

Candidates demonstrate an understanding of the foundations of the solution chemistry contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of solution chemistry and its underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates predict and explain the properties and behaviors of acids, bases, and salts in solution. They explain the properties of various solutions.

4.1 Solutions

- a. Recognize and identify solutes and solvents
- b. Calculate concentration in terms of molarity, parts per million, and percent composition
- c. Describe the dissolving process at the molecular level
- d. Explain how factors such as temperature, pressure, and surface area affect the dissolving process
- e. Describe various methods for separation of solutions (e.g., chromatography, distillation)

(Science Content Standards for California Public Schools, Grades 9-12, Chemistry: 6a-d, 6f)

4.2 Acids and Bases

- a. Distinguish between strong and weak acids and bases based on degree of dissociation and their chemical properties
- b. Calculate pH and hydrogen ion concentration in solutions including buffer solutions
- c. Use Arrhenius, Brønsted-Lowry, and Lewis acid-base definitions appropriately to characterize acids and bases and in acid-base reactions

(Science Content Standards for California Public Schools, Grades 9-12, Chemistry: 5a-g)

Domain 5. Chemical Thermodynamics

Candidates demonstrate an understanding of the foundations of the chemical thermodynamics contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of chemical thermodynamics and its underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates demonstrate by solving problems an understanding that energy is exchanged or transformed in all chemical reactions and physical changes of matter. They apply the concepts of thermodynamic

properties of materials such as specific heat, heats of fusion, heats of vaporization, and heat of reaction (enthalpy).

5.1 Chemical Thermodynamics

- a. Perform calculations using specific heat, heats of fusion, heats of vaporization, and heat of reaction (enthalpy)
- b. Interpret phase diagrams

(Science Content Standards for California Public Schools, Grades 9-12, Chemistry: 7b, 7e)

Domain 6. Organic Chemistry and Biochemistry

Candidates demonstrate an understanding of the foundations of the organic chemistry and biochemistry contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of organic chemistry and biochemistry and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates demonstrate understanding that the bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties, and provide the biochemical basis of life.

6.1 Organic Chemistry and Biochemistry

- a. Explain the bonding characteristics of carbon
- b. Recognize the chemical structure of various organic functional groups (i.e., alcohols, ketones, ethers, amines, esters, aldehydes, and organic acids) and provide examples of reactions involving these groups
- c. Inventory the ten simplest hydrocarbons that contain single bonds, multiple bonds, and benzene rings
- d. Understand the differences in structures and properties between amino acids and their polymers and between sugars and their polymers

(Science Content Standards for California Public Schools, Grades 9-12, Chemistry: 10b-f)

Domain 7. Nuclear Processes

Candidates demonstrate an understanding of the foundations of the nuclear processes contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of nuclear processes and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates explain nuclear processes including the radioactive decay of naturally occurring and human-made isotopes, nuclear fission, and nuclear fusion (e.g., stellar nucleosynthesis and synthesis of transuranium elements). They apply understanding of these processes to discuss the benefits and hazards of the use of radiation and radioactivity.

7.1 Nuclear Processes

- a. Understand how mass-energy relationships in nuclear reactions and radioactive decay requires the relationship $E=mc^2$

- b. Compare and contrast alpha, beta, and gamma decay, and the relative kinds of damage to matter caused by α -, β -, and γ - rays
- c. Perform calculations involving half-life
- d. Contrast the benefits and hazards of the use of radiation and radioactivity

(Science Content Standards for California Public Schools, Grades 9-12, Chemistry: 11b, 11d-f; Investigation and Experimentation: 1m)

Earth and Planetary Science Subject Matter Requirements

Part I: Content Domains for Subject Matter Understanding and Skill in Earth and Planetary Science

Domain 1. Earth's Place in the Universe

Candidates demonstrate an understanding of Earth's place in the universe as contained in the Science Content Standards for California Public Schools (1998) and outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of the solar system and its underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates understand how Earth-based and space-based astronomy reveal the structure, scale, and changes in stars, galaxies, and the universe over time, and how astronomy and planetary exploration reveal the solar system's structure, scale, and change over time. They base this understanding on their knowledge of the characteristics and properties of phenomena such as galaxies, stars, and bodies of the solar system.

1.1 Galaxies and Stars

- a. Identify and describe characteristics of galaxies
- b. Explain the evidence for the "big bang" model
- c. Know that the Sun is a typical star and is powered by nuclear reactions, primarily the fusion of hydrogen to form helium
- d. Describe the process of the nuclear synthesis of chemical elements and how accelerators simulate the conditions for nuclear synthesis (i.e., in stars and in the early universe)
- e. Compare the use of visual, radio, and X-ray telescopes to collect data that reveal that stars differ in their life cycles
- f. Describe, in terms of color and brightness, how the evolution of a star is determined by a balance between gravitational collapse and nuclear fusion

(Science Content Standards for California Public Schools, Grades 9-12, Earth Sciences: 1e, 2b-g)

1.2 Solar Systems

- a. Explain how the solar system was formed, including differences and similarities among the sun, terrestrial planets, and the gas planets, and cite the evidence from Earth and moon rocks that indicate that the solar system was formed approximately 4.6 billion years ago
- b. Know the current evidence for the existence of planets orbiting other stars
- c. Describe changes in the solar system over time

(Science Content Standards for California Public Schools, Grades 9-12, Earth Sciences: 1a, 1b, 1g)

1.3 Planets and Satellites

- a. Cite various forms of evidence that indicate the proximity of the planets in the solar system in relation to Earth and the stars
- b. Cite various forms of evidence that Earth and other planets change over time

- c. Describe the influence of collisional processes on early Earth and other planetary bodies in terms of shaping planetary surfaces and affecting life on Earth

(Science Content Standards for California Public Schools, Grades 9-12, Earth Sciences: 1c, 1d, 1f)

Domain 2. Planet Earth

Candidates demonstrate an understanding of the foundations of Earth contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of Earth and its underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates demonstrate an understanding of the dynamic processes of the solid Earth, oceans, and the atmosphere. Candidates understand how plate tectonics operating over geologic time have changed the patterns of land, sea, and mountains on Earth's surface. Candidates also understand the dynamic processes that operate in and among the atmosphere, oceans and other water bodies, and the biosphere. They understand how life has changed Earth's atmosphere, and how changes in the atmosphere affect conditions for life. Candidates apply their knowledge of dynamic Earth processes to make predictions and form conclusions about surface phenomena such as earthquakes.

2.1 Tectonic Processes

- a. Diagram the major divisions of the geologic time scale as a basis for understanding changes in the Earth's processes
- b. Describe how earthquake intensity, magnitude, epicenter, focal mechanism, and distance are determined from a seismogram
- c. Compare major types of volcanoes in terms of shape and chemical and rock composition
- d. Describe the location and characteristics of volcanoes that are due to hot spots and those due to subduction
- e. Relate geologic structures to tectonic settings and forces
- f. Describe the evidence for plate tectonics on the sea floor and on land

(Science Content Standards for California Public Schools, Grade 7: 3c, 4b, 4d, 4g; Grades 9-12, Earth Sciences: 1c, 3a-b, 3d-f)

2.2 Oceans

- a. Describe the chemical and physical properties of sea water
- b. Describe the mechanisms that cause wave action and tides
- c. Explain the layered structure of the oceans, including the generation of horizontal and vertical ocean currents and the geographic distribution of marine organisms, and how properties of ocean water, such as temperature and salinity, are related to these phenomena

(Science Content Standards for California Public Schools, Grades 9-12, Earth Sciences: 5d)

2.3 Atmosphere

- a. Compare the layers of the atmosphere in terms of chemical composition and thermal structure

- b. Discuss the evolution of Earth's atmosphere over geologic time, including the effects of outgassing, the variations of carbon dioxide concentration, and the origin of atmospheric oxygen
- c. Know the location of the ozone layer in the upper atmosphere, explain its role in absorbing ultraviolet radiation, and explain the way in which this layer varies both naturally and in response to human activities
- d. Identify the bands at specific latitudes where rainforests and deserts are distributed and the causes of this pattern

(Science Content Standards for California Public Schools, Grades 9-12, Earth Sciences: 5e-f, 8a-c)

Domain 3. Energy in the Earth System

Candidates demonstrate an understanding of energy in the Earth system contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of energy in the Earth system and its underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates understand how energy enters, flows through, and leaves the Earth system, and the relationship between energy transfer and the dynamic processes of the Earth system. They base this on knowledge of how energy enters the Earth system primarily as solar radiation and eventually escapes as heat, and how heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents. Candidates apply their knowledge of dynamic Earth processes to make predictions and form conclusions about surface phenomena such as climate.

3.1 Earth's Energy Budget: Inflow and Outflow

- a. Compare the amount of incoming solar energy, the Earth's internal energy, the energy used by society, and the energy reflected back to space
- b. Describe what happens to incoming solar radiation as it relates to reflection, absorption, and photosynthesis
- c. Explain the mechanism and evaluate the significance of the greenhouse effect
- d. Differentiate among greenhouse conditions on Earth, Mars, and Venus; the origins of those conditions; and the climatic consequences of each

(Science Content Standards for California Public Schools, Grades 9-12, Earth Sciences: 4a-d, 6a)

3.2 Circulation in the Oceans and Atmosphere

- a. Assess the differential effects of heating on circulation patterns in the atmosphere and oceans
- b. Relate the rotation of Earth to the circular motions of ocean currents and air in low- and high-pressure centers
- c. Compare the causes and structures of various cloud types, precipitation, air masses, and fronts, and the causes and effects of different types of severe weather

- d. Know and explain features of the ENSO cycle (El Niño southern oscillation, including La Niña) in terms of sea-surface and air temperature variations across the Pacific, and climatic results of this cycle

(Science Content Standards for California Public Schools, Grade 5: 3b-c, 4c; Grades 9-12, Earth Sciences: 5a-b, 5g)

3.3 Climate Variations in Time and Space

- a. Analyze weather (short-term) and climate (over time) in relation to the transfer of energy into and out of the atmosphere
- b. Discuss and assess factors that affect climate including latitude, elevation, topography, and proximity to large bodies of water and cold or warm ocean currents

(Science Content Standards for California Public Schools, Grades 9-12, Earth Sciences: 5e, 6a, 6b)

Domain 4. Biogeochemical Cycles

Candidates demonstrate an understanding of the foundations of the biogeochemical cycles contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of biogeochemical cycles and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates demonstrate an understanding of how each element on Earth moves among reservoirs, which exist in the solid earth, in oceans, in the atmosphere, and within and among organisms as part of biogeochemical cycles. Candidates understand how the movement of matter among reservoirs is driven by Earth's internal and external sources of energy.

4.1 Rock Cycle

- a. Compare and contrast the properties of rocks based on physical and chemical conditions in which rocks are formed, including plate tectonic processes
- b. Identify common rock-forming minerals (e.g., feldspars, quartz, biotite, calcite) using a table of diagnostic properties
- c. Identify common ore minerals as sources of copper, iron, lead, zinc, cement, halite, gypsum, and uranium

(Science Content Standards for California Public Schools, Grade 4: 4b, 6c; Grades 9-12, Earth Sciences: 3c)

4.2 Water, Carbon, and Nitrogen Cycles

- a. Illustrate the mechanism that drives the water cycle
- b. Compare the processes of photosynthesis and respiration in terms of reservoirs of carbon and oxygen
- c. Identify the carbon reservoirs (i.e., physical and chemical forms of carbon in the atmosphere, oceans, biomass, soils, fossil fuels, and solid earth) and describe the movement of carbon among these reservoirs in the global carbon cycle

- d. Describe the nitrogen cycle as it relates to the atmosphere, soils as reservoirs, life processes, and pollution

(Science Content Standards for California Public Schools, Grades 9-12, Earth Sciences: 7a-d)

Domain 5. California Geology

Candidates demonstrate an understanding of the foundations of the California geology contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of California geology and its underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates understand that the geology of California underlies the state's scenic diversity and wealth of natural resources as well as its natural hazards. Candidates are familiar with the geology of California, and are aware of the unique opportunities for field experiences in the state. Candidates describe activities using geologic maps that illustrate processes, location, and scale of phenomena. Candidates also describe field experiences that include the basic elements of geologic mapping to record and interpret the history of geological processes portrayed in California.

5.1 Tectonic Evolution

- a. Interpret geologic maps as a basis for understanding the tectonic evolution of California in terms of plate margins (i.e., Atlantic-type passive margin, Japanese volcanic arc, Andean arc, and faulted margin)

(Science Content Standards for California Public Schools, Grades 9-12, Earth Sciences: 9d, Investigation and Experimentation: 1h)

5.2 Major Economic Earth Resources

- a. Understand the importance of water to society, the origins of California's fresh water, statewide water distribution, and the environmental and economic impact of water redistribution
- b. Describe resources of major economic importance in California and their relation to California's geology (e.g., oil, gas, gold, sand, gravel, salts, open space, soil, arable land, clean air)

(Science Content Standards for California Public Schools, Grade 6: 6b; Grades 9-12, Earth Sciences: 9a, 9c)

5.3 Surface Processes

- a. Assess mechanisms by which tectonics, geologic structures (i.e., folds and faults), and rock properties influence surface properties (e.g., flow of water, differential erosion, uplift, subsidence)
- b. Discuss the factors controlling the influence of water in modifying the landscape
- c. Interpret the factors controlling erosion, deposition, and transport in surficial processes
- d. Appraise desert environments in terms of water resource needs for habitation

(Science Content Standards for California Public Schools, Grade 4: 5b-c; Grade 6: 2a-c)

5.4 Natural Hazards

- a. Analyze published geologic hazard maps of California and know how to use maps to identify evidence of geologic events of the past and to predict the likelihood of geologic changes in the future

(Science Content Standards for California Public Schools, Grades 9-12, Earth Sciences: 9b, 9d, Investigation and Experimentation: 1h)

5.5 Geologic Mapping

- a. Know how to find position using a topographic map
- b. Know how to make a geologic map showing faults, structural data, and contacts between formations
- c. Know how to interpret geologic history and processes from a geologic map

(Science Content Standards for California Public Schools, Grade 6: 7f; Grades 9-12: Earth Sciences, 9d; Investigation and Experimentation; 1h)

Physics Subject Matter Requirements

Part I: Content Domains for Subject Matter Understanding and Skill in Physics

Domain 1. Motion and Forces

Candidates demonstrate an understanding of the foundations of motion and forces as contained in the Science Content Standards for California Public Schools (1998) and outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of motion and forces and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates demonstrate an understanding of motion and the relationship of force to motion. Candidates use analytical, numerical, and graphical methods in problem-solving.

1.1 Motion and Forces

- a. Solve problems using Newton's Second Law (e.g., problems involving time, velocity, and space-dependent forces)
- b. Construct appropriate free-body diagrams of many-body problems (e.g., two or more coupled masses)
- c. Solve periodic motion problems
- d. Solve 2-dimensional problems involving vector analysis of motion and forces, including projectile motion, uniform circular motion, and statics
- e. Generate and understand functional relationships of graphs showing distance, velocity, and acceleration versus time
- f. Recognize relationships among variables for linear motion and rotational motion
- g. Solve problems involving linear and rotational motion in term of forces and torques

(Science Content Standards for California Public Schools, Grades 9-12, Physics: 1a-m)

Domain 2. Conservation of Energy and Momentum

Candidates demonstrate an understanding of the conservation of energy and momentum contained in the Science Content Standards for California Public Schools (1998) and outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of conservation of energy and momentum and of their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates demonstrate an understanding of the principles of conservation of energy and momentum. They apply this understanding to predict and describe the movement of objects.

2.1 Conservation of Energy and Momentum

- a. Use conservation of energy to characterize kinetic-potential energy systems such as oscillating systems (pendula and springs), projectile motion, and roller coasters
- b. Analyze elastic and inelastic collisions and solve for unknown values
- c. Solve problems involving linear and rotational motion in terms of conservation of momentum and energy
- d. Recognize relationships between energy/momentum conservation principles and Newton's Laws

- e. Examine the impact of friction on conservation principles
- f. Interpret force-versus-time and force-versus-distance graphs to find, for example, work done or impulse on a system

(Science Content Standards for California Public Schools, Grades 9-12, Physics: 2a-h)

Domain 3. Heat and Thermodynamics

Candidates demonstrate an understanding of the foundations of heat and thermodynamics as contained in the Science Content Standards for California Public Schools (1998) and outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of heat and thermodynamics and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates demonstrate understanding of the laws of thermodynamics and the thermodynamic properties of materials.

3.1 Heat and Thermodynamics

- a. Solve problems involving the laws of thermodynamics using the relationships among work, heat flow, energy, and entropy
- b. Define and correctly apply thermodynamic properties of materials such as specific heat (heat capacity), heats of fusion, heat of vaporization, thermal conductivity, and thermal expansion to solve problems
- c. Solve problems for ideal gas systems
- d. Solve problems involving cyclic processes, including calculations of work done, heat gain/loss, , and entropy change
- e. Interpret graphs showing phase changes and graphs of cyclic processes
- f. Describe a plasma, state its characteristic properties, and contrast it with an ideal gas

(Science Content Standards for California Public Schools, Grades 9-12, Physics: 3a-g)

Domain 4. Waves

Candidates demonstrate an understanding of the foundations of waves as contained in the Science Content Standards for California Public Schools (1998) and outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of waves and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates can describe waves and their characteristic properties and understand that these properties do not depend on the type of wave. They use their knowledge of waves and wave properties to predict wave behavior under various conditions. Candidates are familiar with the electromagnetic spectrum.

4.1 Waves and Their Characteristic Properties

- a. Relate wave propagation to properties of materials (e.g., predict wave speed from density and tension)
- b. Describe, distinguish, and solve both conceptual and numerical problems involving interference, diffraction, refraction, reflection, Doppler effect, polarization, dispersion, and scattering

(Science Content Standards for California Public Schools, Grades 9-12, Physics: 4a-f)

Domain 5. Electromagnetism

Candidates demonstrate an understanding of the foundations of electromagnetism contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of electromagnetism and its underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates understand the relationship between electric and magnetic phenomena and can apply their knowledge to real-life examples. They can solve calculus-based problems using the quantitative and vector relationships among charges, currents, forces, and fields.

5.1 Electric and Magnetic Phenomena

- a. Analyze electric and magnetic forces, charges, and fields using Coulomb's law, the Lorentz force, and the right-hand rule
- b. Apply energy principles to analyze problems in electricity, magnetism, and circuit theory involving capacitors, resistors, and inductors
- c. Calculate power, voltage changes, current, and resistance in multiloop circuits involving capacitors, resistors, and inductors
- d. Interpret and design mixed series and parallel circuits involving capacitors, resistors, and inductors
- e. Solve problems involving the relationships between electric and magnetic phenomena
- f. Explain properties of transistors, diodes, and semiconductors

(Science Content Standards for California Public Schools, Grades 9-12, Physics: 5a-o)

Domain 6. Quantum Mechanics and the Standard Model of Particles

Candidates demonstrate an understanding of the foundations of quantum mechanics and the standard model of particles contained in the Science Content Standards for California Public Schools (1998) as outlined in the Science Framework for California Public Schools: Kindergarten Through Grade Twelve (2002) from an advanced standpoint. To ensure a rigorous view of quantum mechanics and the standard model of particles and their underlying structures, candidates have a deep conceptual knowledge of the subject matter. Candidates are familiar with the standard model of particles and the four fundamental forces of nature. They recognize the assumptions and principles of early quantum mechanics.

6.1 Quantum Mechanics and the Standard Model

- a. Distinguish the four fundamental forces of nature, describe their ranges, and identify their force carriers
- b. Evaluate the assumptions and relevance of the Bohr model of the atom

(Science Content Standards for California Public Schools, Grades 9-12, Chemistry: 1i)

Part II: Subject Matter Skills and Abilities Applicable to the Content Domains in Science

Domain 1. Investigation and Experimentation

Candidates for Single Subject Teaching Credentials in Science formulate and conduct scientific investigations. They select appropriate scientific tools, make relevant measurements of changes in natural phenomena, and present unbiased findings in logical and meaningful formats using charts, maps, tables, models, graphs, and labeled diagrams. Candidates apply mathematics to scientific investigations and experimentation(s) for the purpose of quantifying results and drawing conclusions. Candidates interpret experimental results and determine whether further information is necessary to formulate accurate conclusions. They communicate results through various methods, and use technology where appropriate.

1.1 Question Formulation

- a. Formulate and evaluate a viable hypothesis
- b. Recognize the value and role of observation prior to question formulation
- c. Recognize the iterative nature of questioning
- d. Given an experimental design, identify possible hypotheses that it may test

(Science Content Standards for California Public Schools, Grade 6: 7a)

1.2 Planning a Scientific Investigation (including Experimental Design)

- a. Given a hypothesis, formulate an investigation or experimental design to test that hypothesis
- b. Evaluate an experimental design for its suitability to test a given hypothesis
- c. Distinguish between variable and controlled parameters

(Science Content Standards for California Public Schools, Grade 5: 6c-d; Grade 8: 9a, 9c)

1.3 Observation and Data Collection

- a. Identify changes in natural phenomena over time without manipulating the phenomena (e.g., a tree limb, a grove of trees, a stream, a hill slope)
- b. Analyze the locations, sequences, and time intervals that are characteristic of natural phenomena (e.g., locations of planets over time, succession of species in an ecosystem)
- c. Select and use appropriate tools and technology (e.g., computer-linked probes, spreadsheets, graphing calculators) to perform tests, collect data, analyze relationships, and display data
- d. Evaluate the precision, accuracy, and reproducibility of data
- e. Identify and analyze possible reasons for inconsistent results, such as sources of error or uncontrolled conditions
- f. Identify and communicate sources of unavoidable experimental error
- g. Recognize the issues of statistical variability and explain the need for controlled tests
- h. Know and evaluate the safety issues when designing an experiment and implement appropriate solutions to safety problems
- i. Appropriately employ a variety of print and electronic resources (e.g., the World Wide Web) to collect information and evidence as part of a research project

- j. Assess the accuracy validity and reliability of information gathered from a variety of sources

(Science Content Standards for California Public Schools, Grade 3: 5a; Grade 6: 7a-b, 7g-h; Grade 7: 7a-b; Grade 8: 9b; Grades 9-12, Investigation and Experimentation: 1a-c, 1i-j, 1m)

1.4 Data Analysis/Graphing

- a. Construct appropriate graphs from data and develop qualitative and quantitative statements about relationships between variables
- b. Recognize the slope of the linear graph as the constant in the relationship $y=kx$ and apply this principle in interpreting graphs constructed from data
- c. Apply simple mathematical relationships to determine a missing quantity in an algebraic expression, given the two remaining terms (e.g., speed = distance/time, density = mass/volume, force = pressure x area, volume = area x height)
- d. Determine whether a relationship on a given graph is linear or non-linear and determine the appropriateness of extrapolating the data
- e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions

(Science Content Standards for California Public Schools, Grade 6: 7c; Grade 8: 9d-g; Grades 9-12, Investigation and Experimentation: 1e)

1.5 Drawing Conclusions and Communicating Explanations

- a. Draw appropriate and logical conclusions from data
- b. Communicate the logical connection among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence
- c. Communicate the steps and results of an investigation in written reports and oral presentations
- d. Recognize whether evidence is consistent with a proposed explanation
- e. Construct appropriate visual representations of scientific phenomenon and processes (e.g., motion of Earth's plates, cell structure)
- f. Read topographic and geologic maps for evidence provided on the maps and construct and interpret a simple scale map

(Science Content Standards for California Public Schools, Grade 5: 6g; Grade 6: 7e-f; Grade 7: 7c-e; Grade 8: 9a; Grades 9-12, Investigation and Experimentation: 1d, 1h)

Domain 2. Nature of Science

Candidates recognize that science is an active endeavor in which acquisition of knowledge is based upon the collection and examination of data. Candidates understand that scientists have a responsibility to report fully and openly the methods and results of their observations and experiments, even if those results disagree with their favored hypotheses or are controversial in public opinion. They understand that to hide data, arbitrarily eliminate data, or conceal how an experiment was conducted is to invite errors, make those errors difficult to discover, and risk harm to colleagues and communities. They understand that scientists carefully consider questions and challenges raised by fellow scientists about the assumptions, procedures, and accuracy of their experiments. They understand that a fundamental aspect of scientific inquiry is that it is dynamic and self-correcting by

design. Conclusions, hypotheses, and theories are tested in every experiment and revised or rejected when they no longer correctly or accurately predict experimental results. Candidates understand that scientists must consider the safety, ethical concerns, risks, and costs and benefits of experiments to society.

2.1 Scientific Inquiry

- a. Distinguish among the terms hypothesis, theory, and prediction as used in scientific investigations
- b. Evaluate the usefulness, limitations, and interdisciplinary and cumulative nature of scientific evidence as it relates to the development of models and theories as representations of reality
- c. Recognize that when observations do not agree with an accepted scientific theory, either the observations are mistaken or fraudulent, or the accepted theory is erroneous or incorrect
- d. Understand that reproducibility of data is critical to the scientific endeavor
- e. Recognize that science is a self-correcting process that eventually identifies misconceptions and experimental biases
- h. Recognize that an inquiring mind is at the heart of the scientific method and that doing science involves thinking critically about the evidence presented, the usefulness of models, and the limitations of theories
- i. Recognize that theories are judged by how well they explain observations and predict results and that when they represent new ideas that are counter to mainstream ideas they often encounter vigorous criticism
- j. Recognize that when observations, data, or experimental results do not agree, the unexpected results are not necessarily mistakes; to discard the unusual in order to reach the expected is to guarantee that nothing but what is expected will ever be seen
- k. Know why curiosity, honesty, openness, and skepticism are so highly regarded in science and how they are incorporated into the way science is carried out

(Science Content Standards for California Public Schools, Grade 6: 7e; Grades 9-12, Investigation and Experimentation: 1f-g, 1n)

2.2 Scientific Ethics

- a. Understand that honesty is at the core of scientific ethics; first and foremost is the honest and accurate reporting of procedures used and data collected
- b. Know that all scientists are obligated to evaluate the safety of an investigation and ensure the safety of those performing the experiment
- c. Know the procedures for respectful treatment of all living organisms in experimentation and other investigations

2.3 Historical Perspectives

- a. Discuss the cumulative nature of scientific evidence as it relates to the development of models and theories
- b. Recognize that as knowledge in science evolves, when observations do not support an accepted scientific theory, the observations are reconsidered to determine if they are mistaken or fraudulent, or if the accepted theory is erroneous or incomplete (e.g., an erroneous theory is the Piltdown Man fossil; an incomplete theory is Newton's laws of gravity)

- c. Recognize and provide specific examples that scientific advances sometimes result in profound paradigm shifts in scientific theories
- d. Discuss the need for clear and understandable communication of scientific endeavors so that they may be reproduced and why reproduction of these endeavors is important

(Science Content Standards for California Public Schools, Grade 6: 7d; Grade 7: 7c, 7e; Grades 9-12, Investigation and Experimentation: 1k, 1n)

Domain 3. Science and Society

Candidates understand that science relies on basic human qualities such as reasoning, insight, curiosity, skill, and creativity – as well as on scientific habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. Candidates recognize their responsibility to increase scientific literacy so that the general population can understand current issues and appreciate their personal roles and responsibilities. Candidates know about possible hazards and take precautions that are the basis for creating a safe learning environment that benefits all students. They are familiar with established rules and guidelines that intend to ensure the safety of students and to protect the subjects and environments studied. Candidates understand that technology is the application of proven scientific knowledge for practical purposes serving human needs; however, science and technology are interrelated—one often propels the other.

3.1 Science Literacy

- a. Recognize that science attempts to make sense of how the natural and the designed world function
- b. Demonstrate the ability to apply critical and independent thinking to weigh alternative explanations of events
- c. Apply evidence, numbers, patterns, and logical arguments to solve problems
- d. Understand that, although much has been learned about the objects, events and phenomena in nature, there are many unanswered questions, i.e., science is a work in progress
- e. Know that the ability of science and technology to resolve societal problems depends on the scientific literacy of a society

3.2 Diversity

- a. Identify examples of women and men of various social and ethnic backgrounds with diverse interests, talents, qualities and motivations who are, or who have been, engaged in activities of science and related fields

3.3 Science, Technology, and Society

- a. Identify and evaluate the impact of scientific advances on society
- b. Recognize that scientific advances may challenge individuals to reevaluate their personal beliefs

(Science Content Standards for California Public Schools, Grades 9-12, Investigation and Experimentation: 1m, 1n)

3.4 Safety

- a. Choose appropriate safety equipment for a given activity (e.g., goggles, apron, vented hood)

- b. Discuss the safe use, storage, and disposal of commonly used chemicals and biological specimens
- c. Assess the safety conditions needed to maintain a science laboratory (e.g., eye wash, shower, fire extinguisher)
- d. Read and decode MSDS/OSHA (Material Safety Data Sheet/Occupational Safety and Health Administration) labels on laboratory supplies and equipment
- e. Discuss key issues in the disposal of hazardous materials in either the laboratory or the local community
- f. Be familiar with standard safety procedures such as those outlined in the Science Safety Handbook for California Schools (1999)

Social Science Subject Matter Requirements

Part I: Content Domains for Subject Matter Understanding and Skill in History and Social Science

Domain 1. World History

Candidates demonstrate knowledge of the foundations and contexts of the world history contained in the History-Social Science Content Standards for California Public Schools (1998) as outlined in the History-Social Science Framework for California Public Schools (2001) at a post secondary level of rigor. Candidates have both broad and deep conceptual understanding of the subject matter. Candidates study the people, major events, and issues of the major Western and non-Western civilizations from the origins of humankind to the present. In their study of world history, candidates apply higher-level thinking skills. These skills include, but are not limited to, the ability to analyze, interpret, compare and contrast, and synthesize information about significant historical issues in both written and oral presentation. Candidates utilize appropriate research skills and primary and secondary sources. They engage in historiographic thinking, and demonstrate awareness of multiple historical and geographic perspectives. Candidates appreciate the fundamental role geography plays in historical inquiry. They also understand and are able to apply the principles of political science and economics to historical analysis.

1.1 Ancient Civilizations

Candidates analyze the geography, history, and cultures of Africa, Eurasia, and the Americas from the origins of humankind to the decline of the Roman Empire. Candidates:

- a. Describe what is known of the early physical and cultural development of humankind from the Paleolithic era to the agricultural revolution, explaining how the methods of archaeology and anthropology contribute to the understanding of prehistory.
- b. Describe and analyze the impact of human interaction with the physical environment (e.g., climate, landforms, soils, water) on the development of the ancient cultures of Fertile Crescent (e.g. Sumerian, Babylonian, Hebrew), Persia, Egypt, Kush, Greece, India, China, Rome, and pre-Columbian America.
- c. Describe and analyze the religious, social, economic, and political structures of the ancient cultures of Mesopotamia, Persia, Egypt, Kush, Greece, India, China, Rome, and pre-Columbian America, and describe and analyze their intellectual, ethical, scientific, and artistic accomplishments and values.
- d. Describe and analyze the foundations of western political and philosophical thought in ancient Greek, Roman, and Judeo-Christian traditions.
- e. Describe and analyze the foundations of Asian political and philosophical thought found in ancient Chinese and Indian traditions (e.g., Legalism, Taoism, Confucianism, Hinduism, Buddhism).
- f. Describe and analyze the importance and patterns of expansion and contraction of empires, religions, and trade that influenced various regional cultures through the decline of the Roman Empire.

(History-Social Science Content Standards for California Public Schools: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 7.1, 10.1)

1.2 Medieval and Early Modern Times

Candidates trace and analyze historical interpretations of cause and effect, sequence, and correlation of the social, cultural, political, economic, and technological developments in Europe, Africa, Asia, and the Americas from A.D.500-1790. Candidates:

- a. Analyze the impact of geography, including both human and physical features, on the development of medieval and early-modern Asian, African (including sub-Saharan), Middle Eastern, pre-Columbian American, and European civilizations.
- b. Trace the decline of the Western Roman Empire and the development of the Byzantine Empire, and analyze the emergence of these two distinct European civilizations and their views on religion, culture, society, and politics.
- c. Describe the role and expansion of Christianity in medieval and early modern Europe and the Middle East.
- d. Identify the basic tenets of Islam, and describe Islamic society and culture between the beginning of the 7th century and the end of the 18th century.
- e. Analyze the religious and secular contributions of Islam to European, African and Asian civilizations and the impact of medieval Muslim civilization on Asia, Africa, and Europe between the beginning of the 7th century and the end of the 18th century.
- f. Analyze and compare and contrast the development of feudalism as a social, political, and economic system in Europe and Japan.
- g. Compare and contrast the geographic, political, economic, religious, and social structures of pre-Columbian American civilizations in North and South America between A.D. 500 and the end of the 18th century.
- h. Analyze the geographic, political, economic, religious, and social structures of Asia and Africa between A.D. 500 and the end of the 18th century.
- i. Analyze the art, literature, music, science, and technology of the Renaissance and their diffusion and impact throughout Europe.
- j. Analyze the political and religious transformations caused by the Reformation and their impact on Europe.
- k. Analyze the historical developments of the Scientific Revolution and the ideas of the Enlightenment and their effects on social, religious, political, economic, and cultural institutions.

(History-Social Science Content Standards for California Public Schools: 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 7.10, 7.11)

1.3 Modern World History

Candidates trace and analyze the major developments in the modern world from the late 18th century through the present. Candidates:

- a. Describe and evaluate the significance of the “Age of Exploration,” and the main ideas of the Enlightenment and their influences on social, political, religious, and economic thought and practice.
- b. Compare and contrast the American Revolution and the French Revolution and their enduring worldwide effects on political expectations for self-government and individual liberty.
- c. Describe and analyze the emergence of nationalism in the 18th and 19th centuries and its impact on Western, African, and Asian societies.
- d. Analyze the causes and effects of the Industrial Revolution, including its impact on science, technology, and society.

- e. Describe the emergence and origins of new theories regarding politics, economics, literature, and the arts in the 18th, 19th, and 20th centuries.
- f. Analyze the economic, political, social, and geographic factors contributing to the emergence of 19th-century imperialism, and evaluate its impact on Africa, Southeast Asia, China, India, Latin America, and the Philippines.
- g. Compare and contrast the social, political, and economic factors that influenced the Russian revolutions of 1905 and 1917.
- h. Analyze the origins and course of World War I and its effects on Europe and the rest of the world, including its impact on science, technology, the arts, politics, society, economics, and geography.
- i. Analyze the conflict between fascist and Marxist/communist ideologies, and the rise, goals, and policies of dictatorships and totalitarian governments between the two World Wars.
- j. Analyze the origins, course, and consequences of World War II, including the human cost of the war (e.g., the Holocaust), the resulting redrawing of boundaries, and the movement of peoples in Europe, Asia, Africa, and the Middle East.
- k. Analyze the international developments of the post-World War II era, including decolonization, nationalism, nation-building, the development of international organizations, and global migration.
- l. Analyze the Cold War from its origins in the post-World War II 1940s to the dissolution of the Soviet Union in 1991, including its impact on social, cultural, political, economic, technological, and geographic developments in the world.
- m. Analyze the emergence of a global economy and its impact on the environment, epidemiology, and demographics, and the development and impact of the information, technology, and communications revolutions.
- n. Describe the causes and effects of genocide in the 20th century, including, but not limited to, the Armenian genocide, the Holocaust, and post-World War II “ethnic cleansing.”
- o. Explain and evaluate the strategic importance of the Middle East and the volatile political relations within the region.

(History-Social Science Content Standards for California Public Schools: 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.8, 10.9, 10.10, 10.11)

Domain 2. U.S. History

Candidates demonstrate knowledge of the foundations and contexts of the United States history contained in the History-Social Science Content Standards for California Public Schools (1998) as outlined in the History-Social Science Framework for California Public Schools (2001) at a post secondary level of rigor. Candidates have both broad and deep conceptual understanding of the subject matter. Candidates study the people and major events and issues of U. S. history from the colonization of North America to the present. In their study of U.S. history, they apply higher level thinking skills. These skills include, but are not limited to, the ability to analyze, interpret, compare and contrast, and synthesize information about significant historical issues in both written and oral presentation. Candidates utilize appropriate research skills and primary and secondary sources. They engage in historiographic thinking, and are aware of multiple historical and geographic perspectives. Candidates appreciate the fundamental role geography plays in historical inquiry, and they understand and apply the principles of political science and economics to historical analysis of U.S. history.

2.1 Pre-Revolutionary Era and the War for Independence

Candidates describe the pre-Revolutionary era from early European exploration and settlement through the War for Independence. Candidates:

- a. Describe the major American Indian cultural groups and their contributions to early American society.
- b. Explain and analyze the struggle for the control of North America among European powers and the emergence of the 13 colonies under English rule.
- c. Analyze the effects of English, French, Dutch, and Spanish colonial rule on social, economic, and governmental structures in North America, and the relationships of these colonies with American Indian societies.
- d. Describe the institutionalization of African slavery in the Western Hemisphere and analyze its consequences in sub-Saharan Africa.
- e. Analyze the causes for the War for Independence, the conduct of the war, and its impact on Americans.

(History-Social Science Content Standards for California Public Schools: 8.1, 8.2, 8.7, 11.1, 5.1, 5.3)

2.2 The Development of the Constitution and the Early Republic

Candidates describe and analyze the development of the political system of the United States and the ways that citizens participate in it through executive, legislative and judicial processes. Candidates:

- a. Describe and evaluate the impact of the Enlightenment and the unique colonial experiences on the writing of the Declaration of Independence, Articles of Confederation, the Federalist Papers, the Constitution, and the Bill of Rights.
- b. Examine the issues regarding ratification of the Constitution, and compare and contrast the positions of the Federalists and Anti-Federalists.

(History-Social Science Content Standards for California Public Schools: 8.1, 8.2, 8.3, 11.1, 12.1)

2.3 The Emergence of a New Nation

Candidates describe the social, political, and economic developments of the American people between the ratification of the Constitution and the Civil War. Candidates:

- a. Describe the differing visions of the early political parties and explain the reasons for the respective successes and failures of those parties.
- b. Compare the significant political and socioeconomic ideas and issues during the Jeffersonian and Jacksonian periods and contrast how they were implemented in policy and practice.
- c. Describe American foreign policy prior to the Civil War.
- d. Identify and describe the political, social, religious, economic, and geographic factors that led to the formation of distinct regional and sectional identities and cultures.
- e. Describe the purpose, challenges, and economic incentives associated with settlements of the West, including the concept of Manifest Destiny.
- f. Map and analyze the expansion of U.S. borders and the settlement of the West, and describe how geographic features influenced this expansion.
- g. Analyze the evolution of American Indian policy up to the Civil War.

- h. Describe and analyze the impact of slavery on American society, government, and economy, and the contributions of enslaved Africans to America, and trace the attempts to abolish slavery in the first half of the 19th century.
- i. Describe and compare and contrast early 19th-Century social and reform movements and their impact on antebellum American society (e.g., the Second Great Awakening, the temperance movement, the early women's movement, utopianism).

(History-Social Science Content Standards for California Public Schools: 8.3, 8.4, 8.5, 8.6, 8.7, 8.8, 8.9, 8.12, 11.1, 11.11, 11.2)

2.4 Civil War and Reconstruction

Candidates explain and analyze the political, economic, geographic, and social causes and consequences of the Civil War. Candidates:

- a. Interpret the debates over the doctrines of nullification and state secession.
- b. Compare and contrast the strengths and weaknesses of the Union and Confederacy.
- c. Describe the major military and political turning points of the war.
- d. Describe and analyze the physical, social, political, and economic impact of the war on combatants, civilians, communities, states, and the nation.
- e. Compare and contrast plans for Reconstruction with its actual implementation.
- f. Explain and assess the development and adoption of segregation laws, the influence of social mores on the passage and implementation of these laws, and the rise of white supremacist organizations.
- g. Analyze the relationship of the 13th, 14th, and 15th Amendments to Reconstruction, and compare and contrast their initial and later interpretations.

(History-Social Science Content Standards for California Public Schools: 8.10, 8.11, 11.1)

2.5 The “Gilded Age”

Candidates examine the relationship among post-Civil War economic development and political, social, and geographic issues and events in the second half of the 19th century. Candidates:

- a. Describe and analyze the role of entrepreneurs and industrialists and their impact on the United States economy.
- b. Describe and analyze the effects of industrialization on the American economy and society, including increased immigration, changing working conditions, and the growth of early labor organizations.
- c. Explain and analyze the causes for, and the impact of, Populism and Progressivism.
- d. Explain the development of federal Indian policy – including the environmental consequences of forced migration into marginal regions – and its consequences for American Indians.
- e. Analyze the impact of industrialism and urbanization on the physical and social environments of the United States.

(History-Social Science Content Standards for California Public Schools: 8.12, 11.2)

2.6 The U.S. as a World Power

Candidates trace and evaluate the emergence of the U.S. as an economic, diplomatic, and military world power in the early 20th century. Candidates:

- a. Evaluate the debate about American imperialistic policies before, during and following the Spanish-American War.
- b. Analyze the political, economic, and geographic significance of the Panama Canal, the “Open Door” policy with China, Theodore Roosevelt’s “Big Stick” Diplomacy, William Howard Taft’s “Dollar” Diplomacy, and Woodrow Wilson’s Moral Diplomacy.
- c. Evaluate the political, economic, social, and geographic consequences of World War I in terms of American foreign policy and the war’s impact on the American home front.

(History-Social Science Content Standards for California Public Schools: 11.4)

2.7 The 1920s

Candidates analyze the political, social, economic, technological, cultural, and geographic developments of the 1920s. Candidates:

- a. Analyze domestic events that resulted in, or contributed to, the Red Scare, Marcus Garvey’s Back to Africa movement, the Ku Klux Klan, the American Civil Liberties Union, the National Association for the Advancement of Colored People, and the Anti-Defamation League.
- b. Analyze the significance of the passage of the 18th and 19th Amendments as they related to the changing political and economic roles of women in society.
- c. Assess changes in American immigration policy in the 1920s.
- d. Describe new trends in literature, music, and art, including the Harlem Renaissance and the Jazz Age.
- e. Assess the impact of radio, mass production techniques, and the growth of cities on American society.

(History-Social Science Content Standards for California Public Schools: 11.5)

2.8 The Great Depression and the New Deal

Candidates analyze the social, political, economic, and geographic effects of the Great Depression and its impact on the changing role of government in economy and society. Candidates:

- a. Analyze the differing explanations for the 1929 stock market crash, Herbert Hoover’s and Congress’ responses to the crisis, and the implementation of Franklin Delano Roosevelt’s New Deal policies.
- b. Describe and assess the human toll of the Great Depression, including the impact of natural disasters and agricultural practices on the migration from rural Southern and Eastern regions to urban and Western areas.
- c. Analyze the effects of, and controversies arising from, New Deal policies, including the social and physical consequences of regional programs (e.g., the Tennessee Valley Authority, the Central Valley Project).
- d. Trace and evaluate the gains and losses of organized labor in the 1930s.

(History-Social Science Content Standards for California Public Schools: 11.6)

2.9 World War II

Candidates analyze U.S. participation in World War II. Candidates:

- a. Explain the origins of American involvement in World War II, including reactions to events in Europe, Africa, and Asia.

- b. Analyze American foreign policy before and during World War II.
- c. Evaluate and analyze significant events, issues, and experiences during World War II, including:
 - ♦ Internment of people of Japanese ancestry
 - ♦ Allied response to the Holocaust
 - ♦ The experiences and contributions of American fighting forces, including the role of minorities (e.g., the Tuskegee Airmen, the 442nd Regimental Combat Unit, Navajo Code Talkers)
 - ♦ The role of women and minority groups at home
 - ♦ Major developments in aviation, weaponry, communications, and medicine
 - ♦ The significance and ramifications of the decision to drop the atomic bomb
- d. Assess American foreign policy in the aftermath of World War II, using geographic, political, and economic perspectives.

(History-Social Science Content Standards for California Public Schools: 11.7)

2.10 Post-World War II America

Candidates analyze the major issues in post-World War II America. Candidates:

- a. Describe and evaluate the significance of changes in international migration patterns and their impact on society and the economy.
- b. Describe the increased role of the federal government in response to World War II and the Cold War and assess the impact of this increased role on regional economic structures, society, and the political system.
- c. Describe the effects of technological developments on society, politics, and the economy since 1945.
- d. Analyze the major domestic policies of presidential administrations from Harry S Truman to the present.

(History-Social Science Content Standards for California Public Schools: 11.8)

2.11 Post-World War II U.S. Foreign Policy

Candidates analyze U.S. foreign policy since World War II and its impact on the world. Candidates:

- a. Trace the origins of the Cold War.
- b. Analyze the roles of the Truman Doctrine, the Marshall Plan, and military alliances, including the North American Treaty Organization (NATO), the South East Asian Treaty Organization (SEATO), and the Warsaw Pact.
- c. Trace the origins and consequences of the Korean War.
- d. Explain and analyze the relationship between domestic and foreign policy during the Cold War, including McCarthyism.
- e. Analyze the foreign policies of post-World War II presidential administrations and their effect on the Cold War.
- f. Trace the causes, controversies, and consequences of the Vietnam War, its effects on American combatants and civilians, and its continued impact on American society.

(History-Social Science Content Standards for California Public Schools: 11.8, 11.9, 11.11)

2.12 Civil Rights Movement

Candidates trace the reasons for and the development of civil rights from World War II to the present. Candidates:

- a. Examine and analyze the key people, events, policies, and court cases in the field of civil rights from varying perspectives.
- b. Describe the civil rights movements of African Americans and other minority groups and their impacts on government, society, and the economy.
- c. Analyze the development of the women's rights movement and its connections to other social and political movements.

(History-Social Science Content Standards for California Public Schools: 11.10, 11.3)

Domain 3. California History

Candidates demonstrate knowledge of the foundations and contexts of the California history contained in the History-Social Science Content Standards for California Public Schools (1998) as outlined in the History-Social Science Framework for California Public Schools (2001) at a post secondary level of rigor. Candidates have both broad and deep conceptual understanding of the subject matter. Candidates study the history of California from the pre-Columbian period to the present. In this study of California history, they apply higher level thinking skills. These skills include, but are not limited to, the ability to analyze, interpret, compare and contrast, and synthesize information about significant historical issues in both written and oral presentation. Candidates utilize appropriate research skills and primary and secondary sources. They engage in historiographic thinking, and are aware of multiple historical and geographic perspectives. Candidates appreciate the fundamental role geography plays in historical inquiry, and they understand and are able to apply the principles of political science and economics to historical analysis of California history. Candidates understand the relationship between California and U.S. history while also recognizing the political, social, economic, and geographic conditions that make California unique.

3.1 Pre-Columbian Period Through the End of Mexican Rule

Candidates describe analyze the relationship between California's physical geography and its history from the pre-Columbian period through the end of Mexican rule. Candidates:

- a. Describe the geography, economic life, and culture of California's American Indian peoples, as well as their relationship with the environment.
- b. Define and assess the impact of Spanish exploration and colonization, including the establishment of the mission system, ranchos, and pueblos, and their influences on the development of the agricultural economy of early California.
- c. Describe the causes of the Mexican-American War and assess its impact on California.

(History-Social Science Content Standards for California Public Schools: 4.1, 4.2, 8.5, 8.8, 8.9)

3.2 From the Gold Rush to the Present

Candidates describe and analyze the history of California from the Gold Rush to the present. Candidates:

- a. Describe the discovery of gold and assess its consequences on the cultures, societies, politics, and economies of California, including its impact on California Indians and Californios.

- b. Describe the international migration to California in the 19th century, the social, economic, and political responses to this migration, and the contributions of immigrants to the development of California.
- c. Analyze key principles in California's constitutional and political development (including the Progressive Era reforms of initiative, referendum, and recall), and compare and contrast the California and U.S. Constitutions.
- d. Describe 20th century migration to California from the rest of the U.S. and the world, and analyze its impact on the cultural, economic, social, and political evolution of the state.
- e. Identify major environmental issues in California history and their economic, social, and political implications (e.g., water supply and delivery, air/water/soil quality, transportation, energy).

(History-Social Science Content Standards for California Public Schools: 4.3, 4.5, 8.5, 8.8, 8.12, 11.2)

Domain 4. Principles of American Democracy

Candidates demonstrate knowledge of the foundations and contexts of the American democracy contained in the History-Social Science Content Standards for California Public Schools (1998) as outlined in the History-Social Science Framework for California Public Schools (2001) at a post secondary level of rigor. Candidates have both broad and deep conceptual understanding of the subject matter. Candidates study the principles of American democracy and analyze how those principles are put into practice in American politics and government. In their study of American democratic principles and practices, candidates apply higher level thinking skills. These skills include the ability to analyze the effect of governmental structures, economic conditions, and social forces on the distribution and use of power. These skills also include the ability to articulate and defend basic values and principles of democratic government. Candidates utilize appropriate research skills and primary and secondary sources. The study of social science must move beyond rote memorization. Therefore, candidates understand and are able to apply the principles and methodologies of political science, economics, and geography to the study of American democracy. Candidates recognize that knowledge and understanding of the social sciences are intrinsic to political analysis.

4.1 Principles of American Democracy

Candidates explain and analyze the fundamental principles and moral values of American democracy as expressed in the U.S. Constitution and other essential documents. Candidates:

- a. Analyze the influence of ancient Classical and Enlightenment political thinkers and the pre-Revolutionary colonial and indigenous peoples' experience on the development of the American government, and consider the historical contexts in which democratic theories emerged.
- b. Explain and analyze the principles of the Declaration of Independence and how the U.S. Constitution reflects a balance between classical republican and classical liberal thinking.
- c. Evaluate the Founding Fathers' contribution to the establishment of a constitutional system as articulated in the Federalist Papers, constitutional debates, and the U.S. Constitution.
- d. Describe the significance of the Bill of Rights and the 14th Amendment as limits on government in the American constitutional process as compared to English Common Law.
- e. Describe the nature and importance of law in U.S. political theory, including the democratic procedures of law making, the rule of adherence to the law, and the role of civil disobedience.

- f. Analyze the significance and evolving meaning of the principles of American democracy: autonomy/liberty, equality, basic opportunity, debate and deliberation, and representation.
- g. Describe the meaning and importance of each of the rights guaranteed in the Bill of Rights and analyze the reciprocal nature of citizenship, including the obligation to obey the law, serve as a juror, vote, pay taxes, and pursue various avenues of participation open to citizens.
- h. Explain the basis and practice of acquiring American citizenship.

(History-Social Science Content Standards for California Public Schools: 11.1, 12.1, 12.2, 12.3, 12.4)

4.2 Fundamental Values and Principles of Civil Society

Candidates describe and analyze the fundamental values and principles of civil society. Candidates:

- a. Explain and analyze the historical role of religion, religious diversity, and religious discrimination and conflict in American life.
- b. Analyze citizen participation in governmental decision-making in a large modern society and the challenges Americans faced historically to their political participation.
- c. Analyze the evolving practices of citizen collaboration and deliberation, and special interest influence in American democratic decision-making.
- d. Compare and contrast the role of the individual in democratic and authoritarian societies.
- e. Explain how civil society provides opportunities for individuals to promote private or public interests.

(History-Social Science Content Standards for California Public Schools: 12.2, 12.9)

4.3 The Three Branches of Government

Candidates compare and contrast the roles and responsibilities of the three branches of government as established by the U.S. Constitution and describe how these roles and responsibilities have evolved throughout U.S. history. Candidates:

- a. Analyze Articles I, II, and III as they relate to the legislative, executive, and judicial branches of government.
- b. Analyze how and why the existing roles and practices of the three branches of government have evolved.
- c. Describe and analyze the issues that arise as a result of the checks and balances system.
- d. Explain the process by which the Constitution is amended.

(History-Social Science Content Standards for California Public Schools: 12.3, 12.6, 12.9, 12.10, 11.5)

4.4 Landmark U.S. Supreme Court Cases

Candidates analyze landmark U.S. Supreme Court interpretations of the Constitution and the continuing debate about judicial restraint and judicial activism. Candidates:

- a. Analyze the changing interpretations of the Bill of Rights and later constitutional amendments.
- b. Evaluate the effects of the Court's interpretations of the Constitution in *Marbury v. Madison*, *McCullough v. Maryland*, and *United States v. Nixon*.

- c. Describe and analyze the controversies that have resulted over the changing interpretations of civil rights, including, but not limited to, those in *Plessy v. Ferguson*; *Brown v. Board of Education*; *Miranda v. Arizona*; *Roe v. Wade*; *Regents of the University of California v. Bakke*; *Adarand Constructors, Inc. v. Peña*; *United States v. Virginia (VMI)*, and *Bush v. Palm Beach County Canvassing Board*.

(History-Social Science Content Standards for California Public Schools: 12.4)

4.5 Issues Regarding Campaigns for National, State, and Local Elective Offices

Candidates describe the process by which officials are elected and analyze issues regarding political campaigns. Candidates:

- a. Analyze the origin, development, and role of political parties.
- b. Describe the means that citizens use to participate in the political process.
- c. Explain the function and evolution of the College of Electors and analyze its role in contemporary American politics.
- d. Describe and evaluate issues of state redistricting and the political nature of reapportionment.

(History-Social Science Content Standards for California Public Schools: 12.5)

4.6 Powers and Procedures of the National, State, Local and Tribal Governments

Candidates compare the processes of law and policy-making at each of the three levels of government, and contrast them to each other and to tribal governments. Candidates:

- a. Identify the various ways in which federal, state, local, and tribal governments are organized.
- b. Analyze the issues that arise out of the divisions of jurisdiction among federal, state, local, and tribal governments at each level of government; consider their impacts on those different levels of government.
- c. Analyze the sources of power and influence in democratic politics, such as access to and use of the mass media, money, economic interests, and the ability to mobilize groups.

(History-Social Science Content Standards for California Public Schools: 12.6, 8.3)

4.7 The Media in American Political Life

Candidates debate positions on the influence of the media on American political life. Candidates:

- a. Describe the significance of a free press, including the role of the broadcast, print, and electronic media in American society and government.
- b. Analyze the interaction between public officials and the media to communicate and influence public opinion.

(History-Social Science Content Standards for California Public Schools: 12.7, 12.8)

4.8 Political Systems

Candidates compare and contrast the origins, characteristics, and development of different political systems. Candidates:

- a. Explain and analyze different political systems and the philosophies that underlie them, including the parliamentary system.

- b. Analyze problems of new democracies in the 19th and 20th centuries and their internal struggles.

(History-Social Science Content Standards for California Public Schools: 12.8)

4.9 Tensions within our Constitutional Democracy

Candidates analyze tensions within our constitutional democracy. Candidates:

- a. Analyze the constitutional interpretations of the First Amendment's statement about the separation of church and state.
- b. Debate the adequacy of the solution of majority rule and the role of minority rights in a majority-rules system.

(History-Social Science Content Standards for California Public Schools: 12.9)

Domain 5. Principles of Economics

Candidates demonstrate knowledge of the foundations and contexts of the economics contained in the History-Social Science Content Standards for California Public Schools (1998) as outlined in the History-Social Science Framework for California Public Schools (2001) at a post secondary level of rigor. Candidates have both broad and deep conceptual understanding of the subject matter. Candidates study the principles of economics, both in relation to the United States economy and to the international economy. In their study of economics they apply higher level thinking skills. These skills include, but are not limited to, the ability to analyze, interpret, compare, contrast and synthesize information about significant issues in both written and oral presentation. Candidates utilize research skills and different methods of analysis, including the use of marginal analysis, equilibrium analysis, micro and macro analysis and positive and normative analysis skills. They use the skills of economic analysis to explain rational behavior of people and groups encountering experiences of everyday life in the form of tables and numbers, graphical analysis and single equations. Candidates demonstrate how solutions are derived from each form of economic analysis, how they are equivalent, and how they translate from one to another. Economic themes are intrinsic to all of the social science content domains. Therefore, candidates demonstrate the ability to explore issues that feature both theoretical and applied economics.

5.1 Economic Terms and Concepts and Economic Reasoning

Candidates explain the meaning of common economic terms and concepts (e.g., supply and demand) and use economic reasoning (e.g., the equivalence and convertibility of the different forms of economic analysis). Candidates:

- a. Describe the causal relationship between scarcity and choices, and explain opportunity cost and marginal benefit and marginal cost.
- b. Identify the difference between monetary and non-monetary incentives and how changes in incentives cause changes in behavior.
- c. Debate the role of private property as an incentive in conserving and improving scarce resources, including renewable and nonrenewable natural resources.
- d. Describe and analyze the debate concerning the role of a market economy versus a planned economy in establishing and preserving political and personal liberty (e.g., through the works of Adam Smith).

(History-Social Science Content Standards for California Public Schools: 12.1)

5.2 Elements of America’s Market Economy in a Global Setting

Candidates analyze the elements of America’s market economy in a global setting. Candidates:

- a. Describe and analyze the relationship of the concepts of incentives and substitutes to the law of supply and demand.
- b. Describe the effects of changes in supply and/or demand on the relative scarcity, price, and quantity of particular products.
- c. Explain and analyze the roles of property rights, competition, and profit in a market economy.
- d. Explain and analyze how prices reflect the relative scarcity of goods and services and perform the function of allocation in a market economy.
- e. Explain the process by which competition among buyers and sellers determines a market price.
- f. Describe the effect of price controls on buyers and sellers.
- g. Analyze how domestic and international competition in a market economy affects the quality, quantity, and price of goods and services produced.
- h. Explain the role of profit as the incentive to entrepreneurs in a market economy.
- i. Describe the functions of the financial markets.

(History-Social Science Content Standards for California Public Schools: 12.2)

5.3 The Relationship between Politics and Economics

Candidates explain and analyze the debate over the role of the government in the economy and the relationship between politics and economics. Candidates:

- a. Analyze the effects of federal, state, and local policies on the distribution of resources and economic decision-making.
- b. Describe the economic and social effects of government fiscal policies.
- c. Describe the aims and tools of monetary policy and its economic and social effects.
- d. Assess the tradeoff between efficiency and equality in modern mixed economies, using social policies as examples.
- e. Apply the principles of economic decision-making to a current or historical social problem in America (e.g., land development, resource availability, environmental quality, composition of the economy).

(History-Social Science Content Standards for California Public Schools: 12.3, 12.1, 12.6)

5.4 Elements of the U.S. Labor Market in a Global Setting

Candidates describe and analyze the operations of the U.S. labor market. Candidates:

- a. Describe the circumstances surrounding the establishment of principal American labor unions, procedures that unions use to gain benefits for their members, and the effects of unionization, the minimum wage, and unemployment insurance.
- b. Analyze the current U.S. economy and the global labor market that helps support it, including the types of goods and services produced, the types of skills in demand, the effects of rapid technological change, inter- and intra-regional shifts in employment, and the impact of international competition.
- c. Analyze wage differences between jobs and professions, using the laws of supply and demand and the concept of productivity.

- d. Analyze the effects of international mobility of capital, labor, and trade on the U.S. economy.

(History-Social Science Content Standards for California Public Schools: 12.4)

5.5 Aggregate Economic Behavior of the American Economy

Candidates describe the macroeconomic forces at work at the level of the aggregate sectors of the economy. Candidates:

- a. Describe how measures of economic output are adjusted using indexes.
- b. Define, calculate, and analyze the significance of the changes in rates of unemployment, inflation, and real Gross Domestic Product.
- c. Distinguish between short- and long-term interest rates and explain their relative significance.

(History-Social Science Content Standards for California Public Schools: 12.5)

5.6 International Trade and the American Economy

Candidates describe and analyze issues of international trade and explain how the U.S. economy affects, and is affected by, economic forces beyond the United States' borders. Candidates:

- a. Use the concept of comparative advantage to identify the costs of and gains from international trade.
- b. Compare and contrast the arguments for and against trade restrictions during the Great Depression with those among labor, business, and political leaders today.
- c. Analyze the significance of the changing role of international political borders and territorial sovereignty in a global economy (e.g., General Agreement on Trade and Tariffs (GATT), North American Free Trade Agreement (NAFTA), World Trade Organization (WTO), European Union (EU)).
- d. Describe how international currency exchange rates are determined and their significance.

(History-Social Science Content Standards for California Public Schools: 12.6)

Domain 6. Principles of Geography

Candidates demonstrate knowledge of the foundations and contexts of the geography contained in the History-Social Science Content Standards for California Public Schools (1998) as outlined in the History-Social Science Framework for California Public Schools (2001) at a post secondary level of rigor. Candidates have both broad and deep conceptual understanding of the subject matter. Candidates study the principles of geography and their application to the study of history, political science, and economics. In their study of geography, they apply higher level thinking skills. These skills include (but are not limited to) the ability to analyze, interpret, compare and contrast, and synthesize information regarding the geographic character of landscapes, societies, and ecosystems across the earth. They know the five basic themes of geography as stated in the 2000 History-Social Science Framework: location; place; human and environmental interaction; movement; and regions. Candidates use basic map and globe skills, such as latitude/longitude, relative location, distance/direction, scale, legend, map projections, and distortion categories to describe and analyze the world from a geographic perspective.

6.1 Tools and Perspectives of Geographic Study

Candidates use the tools, theories, and methodologies of geography to analyze the history and current issues of the world's peoples and places. Candidates:

- a. Describe the criteria for defining regions and identify why places and regions are important.
- b. Explain the nature of map projections and use maps, as well as other geographic representations and technologies (including remote sensing and geographic information systems) to acquire, process, and report information from a spatial perspective.

(History-Social Science Content Standards for California Public Schools, Grades 6-12, Historical and Social Science Analysis Skills, Chronological and Spatial Thinking, #3)

6.2 Geographic Diversity of Natural Landscapes and Human Societies

Candidates make inter- and intra-regional comparisons and analyze the geographic diversity of human societies, using such concepts as density, distribution, growth, demographic transition, culture, and place identification. Candidates:

- a. Analyze how unique ecologic settings are encouraged by various combinations of natural and social phenomena, including bio-geographic relationships with climate, soil, and terrain.
- b. Analyze the patterns and networks of economic interdependence across the earth's surface during the agricultural, industrial, and post-industrial revolutions, including the production and processing of raw materials, marketing, consumption, transportation, and other measures of economic development.
- c. Describe the processes, patterns, and functions of human settlements from subsistence agriculture to industrial metropolis.
- d. Analyze the forces of cooperation and conflict among peoples and societies that influence the division and control of the earth's surface (e.g., boundaries and frontiers, the control of resources, centripetal vs. centrifugal forces, spheres of influence).

(History-Social Science Content Standards for California Public Schools: 11.6.3, 10.5.2, 12.2.6, 7.2.1, 8.12.1, 10.5.2, 11.2.6)

6.3 Culture and the Physical Environment

Candidates describe and analyze and discuss the geographic interactions between human activities and the physical environment in the past and present, and plan for the future.

Candidates:

- a. Describe and analyze ways in which human societies and settlement patterns develop in response to the physical environment, and explain the social, political, economic, and physical processes that have resulted in today's urban and rural landscapes.
- b. Recognize the interrelationship of environmental and social policy.

(History-Social Science Content Standards for California Public Schools: 6.1.1, 6.1.2, 6.2.1, 6.2.2, 6.4.1, 6.5.1, 6.6.1, 6.6.7, 6.7.3, 7.3.2, 7.3.4, 7.4.2, 7.4.4, 7.6.1, 7.6.3, 7.7.1, 7.8.2, 7.8.3, 7.11.3, 8.6.1, 8.6.2, 8.7.1, 8.8.5, 8.12.1, 8.12.5, 10.3.5, 10.4.1, 10.4.2, 10.10.1, 11.1, 11.2.2, 11.2.6, 11.4, 11.5.7, 11.6.3, 11.8.6, 11.11.5, 6.2.8, 6.6.2, 6.7.1, 7.4.1, 10.10, 6.4.6, 6.5.2, 6.5.6, 7.1.2, 7.2.4, 7.7.3, 8.3.5, 8.5.2, 8.8.6, 8.10.2, 8.10.7, 10.5.2, 10.6.2, 10.8.3, 11.4.2, 11.7.2, 11.9.3)

Part II: Subject Matter Skills and Abilities

Applicable to the Content Domains in Social Science

Throughout their course of study, candidates for a teaching credential have opportunities to demonstrate their ability to apply higher-level thinking, writing, and presentation skills to their study of the social sciences. These skills include (but are not limited to) the ability to analyze, interpret, compare and contrast, and synthesize information about significant social, political, economic, and geographic issues in written, oral, and visual form. Candidates understand, critically assess, and use the different types of information found on the internet and in archives, libraries, museums, and other repositories. They utilize chronological, spatial, interdisciplinary, and thematic thinking. They consider the impact of cultural, political, and ethical perspectives on issues and their interpretation.

Candidates understand the nature of historiography and the necessity of historical revision. They are able to distinguish valid arguments from fallacious arguments in historical interpretations. They identify bias and prejudice in historical interpretations, and evaluate major debates among historians concerning alternative interpretations of the past. Within this evaluation, candidates analyze authors' use of evidence and the distinctions between sound generalizations and misleading oversimplifications. They construct and test hypotheses; collect, evaluate, and employ data from multiple primary and secondary sources; and present it in oral, written, and visual forms.

Candidates demonstrate the connections, causal and otherwise, between particular historical events and larger social, cultural, economic, political, and technological trends. They recognize the complexity of historical causes and effects, including the limitations on determining historical causation. They interpret past events and issues within their historical context rather than solely in terms of present-day norms and values, while understanding that the past and its interpretations can have contemporary relevance. They understand the contingent nature of historical events and recognize that events could have taken other directions.

Candidates draw upon and apply methodologies and approaches of the social sciences to inform their study of history. With regard to methodology, candidates are familiar with issues of hypothesis generation and testing. They are also familiar with the strengths and weaknesses of different methods for gathering data, such as observation, archival research, content analysis, in-depth interviewing, surveys, and experimentation. Candidates understand both qualitative and quantitative methods of data analysis and their respective strengths and weaknesses.

Candidates are aware of the analytical perspectives characteristic of the social sciences as a whole. The social sciences all regard certain issues as fundamental, but address them quite differently. Key points of divergence include how to understand the relationship between the individual and society and whether to focus on culture and language or social structure and behavior. Candidates are able to address the ethical questions raised by social analysis, including such fundamental debates as relativism vs. universalism and individualism vs. collectivism.

(History-Social Science Content Standards for California Public Schools: Grades 6-8 and 9-12: Historical and Social Sciences Analysis Skills)

